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ABSTRACT

The University of Delaware's work with computer-based instruction since 1974 is summarized with attention to the history and development of the Office of Computer-Based Instruction, university applications, outside user applications, and research and evaluation. PLATO was the system that met the university's criteria, which included support for instructional strategies such as gaming, simulation, testing, drill-and-practice self-paced programmed instruction; a library of computer-based learning materials; a programming language that was easy to use; a student record-keeping capability to support educational research; interactive graphics; and an overall system reliability. Information is provided on credit and non-credit courses using computer-based instruction during 1985-86. Activities of the 36 departments and projects using PLATO are summarized, and sample lessons are provided. Outside use applications are also described, including workshops and consulting services, pre-college demonstrations, programming courses, and courseware development. Materials include a model for courseware development, a student evaluation form for PLATO, abstracts of computer-based education developments, and a catalog of PLATO and microcomputer programs under development. (DJR)

THE ELEVENTH SUMMATIVE REPORT OF THE OFFICE OF COMPUTER-BASED INSTRUCTION

BY

FRED T. HOFSTETTER

JULY 1, 1986

University of Delaware
Newark, Delaware

ACKNOWLEDGEMENT

The writing of this Eleventh Summative Report has involved the work of many faculty and staff members at the University of Delaware, and I would like to acknowledge their efforts. To the 258 faculty members who are designing and implementing educational software, I am grateful for the content of the applications section. Faculty interest in using computer-based techniques to improve instruction has resulted in a library of high-quality lessons of which the University can be proud. I am also grateful for the dedication and expertise the OCBI staff has shown in developing and administering the University's computer-based learning programs.

Many staff members helped write this report. I am grateful for the time they spent collecting and organizing information about their projects. A special note of thanks is due Clella Murray, Kenneth Gillespie, Mike Dombrowski, Brian Field, Ronald Ih, and Lisa Scott for the many hours they spent editing and word processing this report. I truly appreciate it.

Fred T. Hofstetter
Director

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INTRODUCTION

This Eleventh Summative Report of the Office of Computer-Based Instruction (OCBI) summarizes instructional computing at the University of Delaware since 1974. Like previous reports, it deals mainly with developments of the past year. More information on the events of prior years can be found in previous summatives, which are available from OCBI. The outline history that is printed on the inside front and back covers of this report provides a capsule summary of the main events in each year.

If one were to characterize 1985-86 with a single phrase, it would be "A Year of Dissemination." Seven major curriculum development projects were completed and distributed to other schools. These include (1) "Library Research Skills," which runs on the IBM PC® and teaches freshman English students how to use the library; (2) "The University of Delaware Videodisc Music Series," which presents eleven musical masterworks with music videos, scrolling scores, analyses, and cultural and historical slides; (3) the "Individualized Latin Curriculum," a utility that uses six audio tapes and an Apple II® computer to manage student records and pacing through a one-semester course in Latin without formal class meetings; (4) "Introduction to Statistics," which uses VAX® computers and the Digital Equipment Corporation's Courseware Authoring System (C.A.S.®) to teach a complete, one-semester course in statistics; (5) "Mathematical Review for Biomechanics (and Related Fields)," ten PLATO® lessons that physical education majors use to sharpen their math skills; (6) "Written Theory Lessons," twenty-five PLATO programs that teach theory as part of the GUIDO Music Learning System; and (7) "Consumer in the Marketplace," sixteen PLATO lessons with sixteen PLATO Learning Management (PLM) modules that teach consumer skills.

Professor James Morrison's Home Interconnect Project laid the groundwork for Home Network, which provides Delawareans with local dial access to the University of Delaware PLATO system. Connect charges range from $1 to $4.50 per hour, depending upon the time of day. Home users have access to PLATO courseware, bulletin boards, and electronic mail services. The University's on-line advisement system is available to home users, as is the transfer of credit matrix, which shows how credits are transferred among Delaware's institutions of higher learning. Microcomputers that can access the home network include the IBM PC family and compatibles, the Macintosh™, and the Atari 400, 600, 800, and 1200®.

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VAX® is the registered trademark of the Digital Equipment Corporation.
C.A.S.® is the registered trademark of the Digital Equipment Corporation.
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Under OCBI's annual call for proposals, fifteen faculty projects were supported. Of these, eleven are on the IBM PC, two are on PLATO, and two are on the Apple II. Two factors contributed to the popularity of the IBM PC. First, 67% of eligible Delaware faculty purchased IBM PCs at greatly reduced prices during a grant program administered by the Office of the Provost for humanities faculty in 1984-85 and the faculty at large during 1985-86; it is natural for faculty members to propose course development on the brand they work with at home. Second, and perhaps more important, courseware developers wish to share their materials with other schools. When this report went to press, more than four million IBM PCs had been sold, of which 500,000 were on college campuses. Many faculty consider the IBM PC to be the most appropriate machine on which to disseminate collegiate courseware.

Dissemination was also a primary focus of the Faculty Committee on Computer-Based Instruction, which issued a 22-page report on the future of educational computing at Delaware. There is strong faculty support for continued development of university courseware, and the committee's charge was to recommend the best environment for producing and publishing it. The committee recommended that the university retain and continue to operate its mainframe PLATO system for a minimum of three years and perhaps until 1995, noting that the TUTOR® language and its derivatives continue to provide the best collection of graphics and judging commands. The committee also noted that the electronic mail, bulletin boards, and student record keeping facilities of PLATO are superior to those offered by other vendors.

At the same time, the committee recognized the growing popularity of the IBM PC. It encouraged OCBI to support a TUTOR-like language on the PC and nominated TenCORE™ and CMU-Tutor as candidates. It recommended that OCBI create a mouse-based access disk to permit the IBM PC to connect to the CYBER® as a PLATO terminal. To bring PLATO more into the mainstream of computing, the committee recommended the linkage of PLATO notes to BITNET mail and the connection of the CYBER mainframe to the University's port selector network.

Information about these and many other CBI projects is contained in this Eleventh Summative Report, which is divided into four chapters, namely, "History and Development," "University Applications," "Outside User Applications," and "Research and Evaluation." Appendix A contains a catalog of courseware published by OCBI, and Appendix B lists University of Delaware courseware published by the Control Data Corporation. Appendix C lists the titles of CBI papers published by UD faculty and staff, and Appendix D contains a catalog of courseware under development at the University of Delaware.

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CHAPTER I. HISTORY AND DEVELOPMENT OF THE OFFICE OF COMPUTER-BASED INSTRUCTION

Background

The Office of Computer-Based Instruction has its origins in deliberations of the University's Computer Applications to Education Committee during the fall of 1974. The committee planned a series of seminars and demonstrations for the purpose of making available to the Delaware faculty information on how a computer-based educational system may function in a university, and of evaluating what part such a system might play in the future of the University and its supporting community. A major portion of the committee's planning consisted of the review and selection of a computer-based educational system that could support the demonstration. The criteria used in making the selection are listed as follows:

1. An overall system design that can support many instructional strategies such as gaming, simulation, testing, drill-and-practice, and self-paced programmed instruction

2. A library of computer-based learning materials encompassing many academic areas

3. A programming language that is both easy for faculty members to learn, and at the same time powerful enough to support instructional computing

4. A student record-keeping capability to support educational research in student learning behaviors

5. High-speed interactive graphics for both textual and pictorial displays

6. A very good overall system reliability

The only system that met these criteria in 1974 was PLATO, and with the installation of the first PLATO terminal on March 14, 1975, the Delaware PLATO Project began. A committee of faculty members from seventeen academic areas coordinated demonstrations of PLATO, encouraged interested faculty members to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the implementation of existing courseware and the development of new PLATO programs.

The outline history printed on the inside of the front and back covers of this report shows how the project grew. Encouraging results from controlled evaluations and student questionnaires led to the adoption of PLATO in forty academic departments. Within three years, the number of PLATO terminals had grown to forty-eight, the break-even point at which it became cheaper for the University to purchase its own PLATO system than lease services over telephone lines. Accordingly, on March 17, 1978, the University of Delaware PLATO System was installed.

Based on a CYBER 174 mainframe, the Delaware PLATO System was initially configured to serve a load of 50 simultaneous PLATO users with one central processor. As the demand for services grew, the PLATO mainframe was gradually upgraded to where it now has two processors, two million words of extended memory, and the capacity to serve 275 simultaneous users. At present, 352 terminal ports are connected to the system.

A significant event in the evolution of the Delaware PLATO System was its entry into the ASCII world on February 24, 1984. ASCII stands for American Standard Code for Information Interchange and provides a way for computers to talk to each other. A network processing unit provides 92 ASCII ports on the Delaware PLATO System. All future PLATO terminals will follow the ASCII format. The ASCII ports also allow microcomputers to access the PLATO System, and in the spring of 1984 OCBI announced mainframe PLATO support for Zenith®, IBM, and Atari® microcomputers. In 1985-86, the Macintosh was added to the list of supported micros.

The Delaware PLATO system is linked to a communications network that allows Delaware authors to exchange materials and ideas with users on other PLATO systems throughout the United States. Figure 1 shows the hardware configuration of the Delaware PLATO system. No longer viewed as an experiment, PLATO is now considered to be a primary tool for research, development, and delivery of high-quality computer-based learning materials in University courses and in the educational programs of schools, businesses, and institutions in its outside user base.

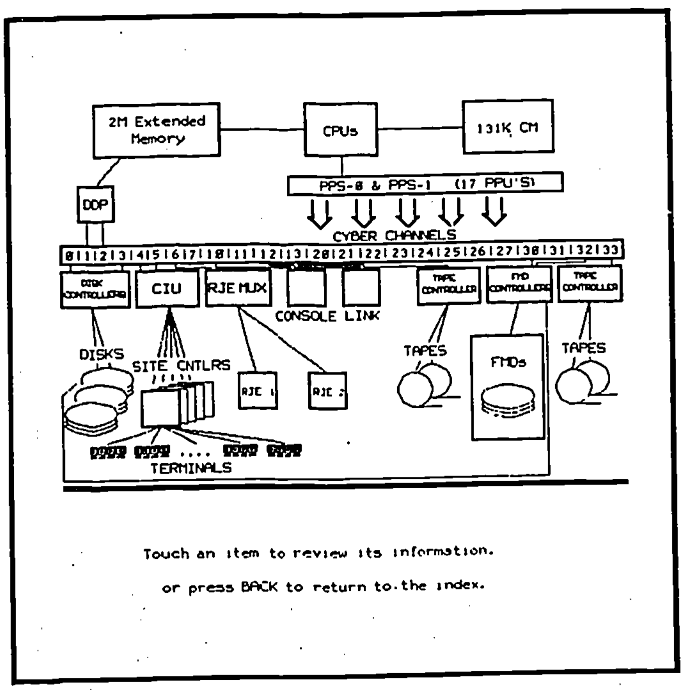

Figure 1. "Delaware PLATO System Hardware Configuration," by Brand Fortner and David G. Anderer. Copyright© 1978 by the University of Delaware.

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Throughout the 1970s, the Office of Computer-Based Instruction dealt exclusively with PLATO. The year 1981 marked the beginning of its involvement with microcomputers. Due to their low cost and the large amount of courseware developed by computer firms, software houses, and textbook publishers, microcomputers were widely used in schools. As an East Coast teacher training site for computer-based education, the University responded to these developments by installing in 1981 a microcomputer facility that contains a variety of microcomputers, courseware packages, and peripherals such as printers, synthesizers, slide projectors, and videodisc players. This facility is being used in the Summer Institutes in Computer-Based Education for teachers, in the Summer Youth Campus for high school students, and in lifelong learning by the Division of Continuing Education. It is also being used as a benchmark laboratory for evaluating network strategies in the long-range planning of OCBI. The microcomputer facility consists of two main parts. First, there is a classroom that contains twenty Apples used for teaching classes in educational programming, and second, there is a demonstration room that contains a variety of microcomputers. Systems currently represented in this demonstration area include Micro PLATO, Apple II+, Apple IIe, Apple Macintosh, Atari 800, Radio Shack™, TRS-80, Radio Shack Color Computer, Commodore PET®, Commodore 64®, IBM PC, IBM PCjr®, Atari 520ST™ and Commodore Amiga™. Also included are peripheral devices such as touch panels, digitizers, speech synthesizers, and Pioneer™ videodisc players.

Just as low-cost microcomputers found their way into schools in the late 1970s, so also did they enter homes in large numbers during the early 1980s. Excited about the graphics and sound chips in the Atari home computer, the University approached Atari with an idea for a home music learning system whereby lifelong learners of age nine and up could learn music at home. Atari did a survey, found there to be a large market for such a package, and in 1982 funded its development by the University of Delaware. The University became a certified Atari development site, and a teaching laboratory containing twenty-one Atari home computers was established in the Department of Music for the purpose of developing, evaluating, and implementing courseware on Atari home computers. In addition to developing the music course, the University also served as a test site for Atari's word processor and LOGO cartridges. Unfortunately, Atari has not fared well in the marketplace, and the music classroom is gradually being converted from Atari 800s to IBM PCs.

The University established its first IBM personal computer laboratory in 1982. Located in the College of Business, this laboratory contains twenty-six IBM PCs. In 1983-84, OCBI worked with the College of Engineering to design two Ethernet networks of personal computers for the Departments of Chemical Engineering and Mechanical and Aerospace Engineering. Each department has twelve IBM PCs that are connected by means of a coaxial cable. CBI lessons and applications software reside on a centralized file server. OCBI supports lesson development for faculty projects in library science, geography, geology, and engineering and teaches seminars in BASIC, Pascal, and business computing on the IBM PCs.

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Commodore Pet®, Commodore 64®, and Amiga™ are the registered trademarks of Commodore Business Machines.
IBM PCjr® is the registered trademark of International Business Machines Incorporated.
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In 1985-86, OCBI worked with Academic Computing Services (ACS) to establish an IBM PC site in Newark Hall. Located in room 155, this joint site contains two clusters of PCs. The first cluster contains twenty-five workstations and can be reserved by instructors for class use; the second cluster contains thirteen PCs devoted to general student use. In the fall of 1986, all of the workstations will be able to connect to ACS and OCBI mainframes via the University's port selector; a mouse will be used to emulate touch in PLATO applications.

Located across the hallway from the Newark Hall joint site is the Microcomputer Resource Center (MRC), a cooperative effort of ACS, OCBI, and Management Information Services (MIS). Established in October of 1985, the MRC demonstrates and sells at University discounts microcomputer hardware and software that is supported by ACS, OCBI, and MIS. Buyers must meet University eligibility requirements in order to make purchases at the MRC. The MRC is administered by ACS, with OCBI and MIS staff members sitting on its advisory board.

In addition to PLATO and the microcomputers, OCBI also operates a VAX 11/780® that was obtained under a grant awarded in 1982 by the Digital Equipment Corporation. Figure 2 shows the system configuration. With two megabytes of main memory, 1024 megabytes of mass storage, and a CPU with a floating-point accelerator capable of performing an addition of 32-bit real numbers in 800 nanoseconds, the system is estimated to have the capacity to support over forty simultaneous CBI users. Running under the VMS operating system, the VAX provides a great deal of flexibility. In addition to supporting traditional computing languages and packages like BASIC, FORTRAN, Pascal, APL, LISP, and MINITAB, it also supports in the same environment a new CBI facility called the Courseware Authoring System (C.A.S.).

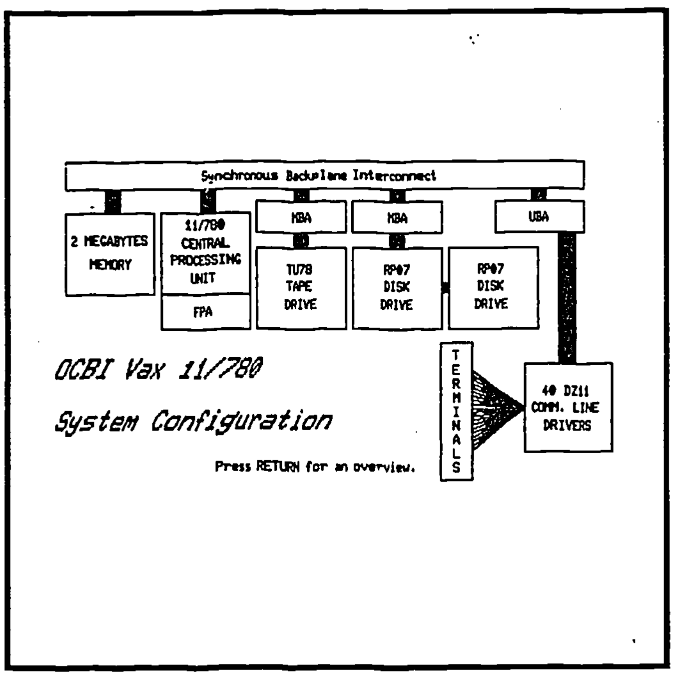

Figure 2. "OCBI VAX 11/780 System Configuration," by David G. Anderer. Copyright© 1983 by the University of Delaware.

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C.A.S. contains a language that can best be described as a structured TUTOR. Under its grant with Digital, the University has converted six PLATO lessons to run under C.A.S. using color GIGI® and VT-241® terminals. It has also developed a first-semester interdisciplinary statistics course that contains tutorials, drills, and problem-solving exercises in descriptive, exploratory, probabilistic, and inferential statistics.

The most interesting personal computer introduced to date is Apple's Macintosh. The Office of Computer-Based Instruction became interested in this machine because of its speed, high-quality graphics, built-in sound, and the ease-of-use produced by combining a mouse with windows, pull-down menus, and menu bars. On May 23, 1984, the University of Delaware became a Certified Apple Developer and opened its "Fat Mac" Development Lab, which supports faculty development of Macintosh courseware.

Another new machine is the Xerox 1108 Artificial Intelligence Workstation, commonly known as the Dandelion. On March 4, 1985, OCBI received two Dandelions and located them in the College of Education's Center for Interdisciplinary Research in Computer-Based Learning. The Dandelion has one and one-half million bytes of main memory, a screen resolution of 1,024 by 808 points, and the windows, menu bars, and mouse that have been popularized by Apple's Macintosh. The Dandelions have a built-in language called LISP that runs interpretively, like BASIC runs in small personal computers. LISP is an artificial intelligence language that Delaware faculty and staff are using to develop Intelligent CAI (ICAI) materials.

Summing up the above, in 1986 the Office of Computer-Based Instruction is supporting development, teacher training, and student use on PLATO and VAX mainframe systems and on Apple, Atari, Macintosh, and IBM personal computers; ICAI research is being conducted on Xerox Dandelions.

GIGI® and VT-241® are the registered trademarks of the Digital Equipment Corporation.

Utilization

Figure 3 shows how there was steady growth in the use of PLATO terminals from 1975 to 1982. The introduction of microcomputers in 1981 and the installation of the VAX in 1982 caused a shift in usage as a growing proportion of computer-based learning materials began to be delivered on other machines.

Figure 3.

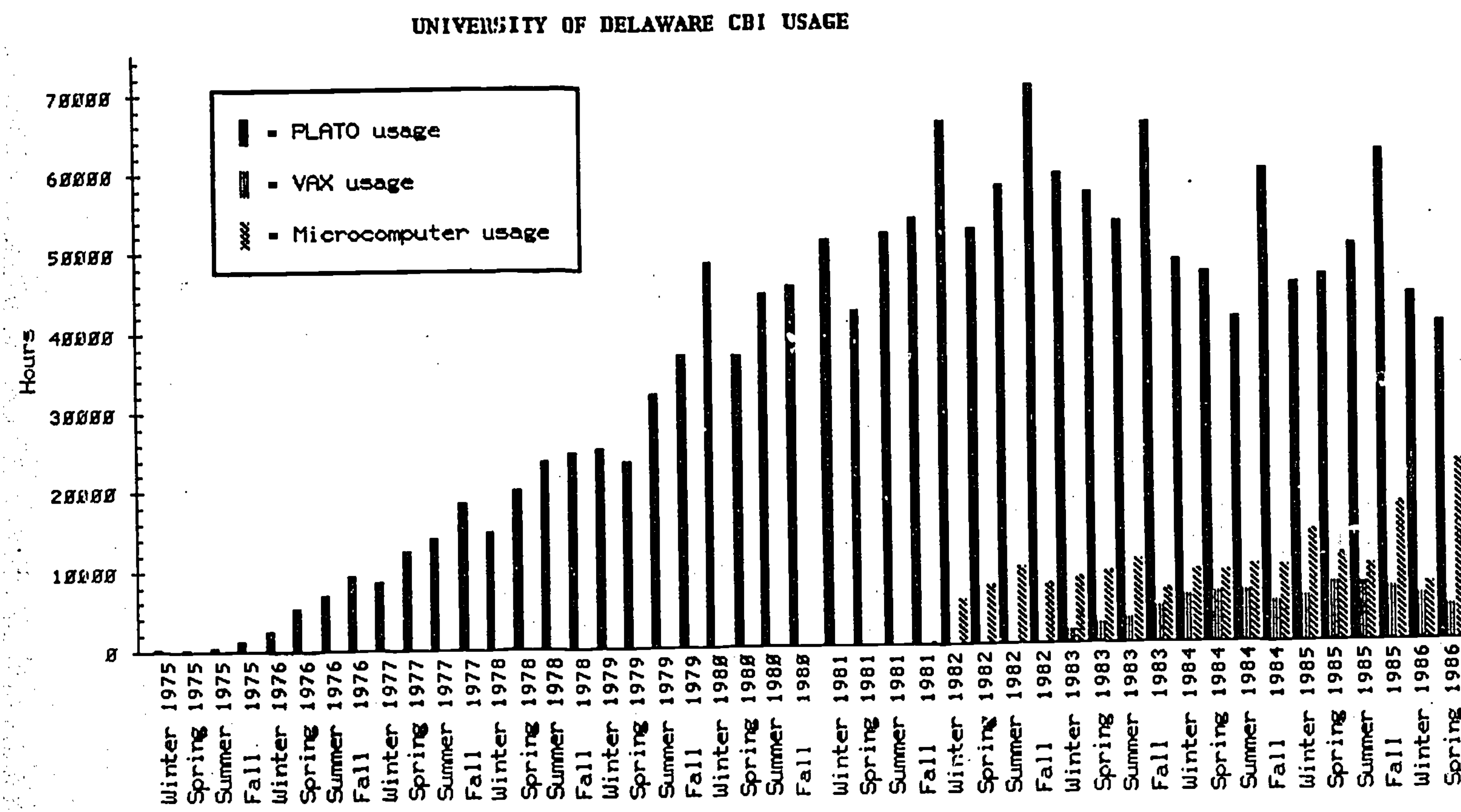

Table 1 shows how 216 courses used computer-based instruction during the 1985-86 academic year. Column one gives the subject and course symbol from the University's course catalog. Column two contains the descriptive title for the course. Column three gives the number of credits. Column four shows how many students used CBI in the course. Column five gives the average number of hours each student used CBI. Column six shows the total number of contact hours for the course. The last four columns indicate whether the course used CBI in the Summer Session, the first semester, the Winter Session, or the second semester. The tabulation of microcomputer usage has an additional column which shows the machine used. During 1985-86, 12,879 students in 110 courses used PLATO, accumulating a total number of 78,706 hours; 139 students in 4 courses used the VAX for a total of 266 hours; and 3,302 students in 102 courses accumulated 40,673 hours on microcomputers. The total number of hours accumulated by students using computer-based instruction during 1985-86 was 119,645, of which 67,045 were spent in credit courses, and 52,600 in non-credit courses.

Credit a

Course Symbol

Course Symbol
by Subject

Descriptiv

Biology

B 115

Human He
Developm

Course Symbol
by Subject

Descriptive

Chemistry (cont.)

C 321 Organic Ch

Course Symbol
by Subject | Descriptiv

Human Resources (cont.)

FSN 440 Nutrition

Course Symbol by Subject

Descriptive

Mathematics

M 010

Intermedia

Course Symbol
by Subject

Descriptiv

Music (cont.)
MU 285

Advanced
Training &
Singing I

Course Symbol
by Subject

Descriptive

Physics

PS 133

Introductio

PLATO Group | Descriptiv

Community Service

CHEMFAME Forum to

in Enginee

PLATO Usage in Non-Credit Courses (continued)

ıp	Descriptive Title	Number of Students	Average Hours of Use per Student	Total Contact Hours	Time of Utilization Sum.	Fall	Win.	Spr.
ervice (cont.)	Pre-College Student Use	M*	-	3513	x	x	x	x
	Upward Bound	M*	-	216	x			
ıtion	Alcohol Abuse Educators for Health Education	10	3.1	31	x			x
)	Peer Educators for Eating Disorders	9	2.6	23				x
	Fitness Educators for Health Education	9	1.0	9	x	x	x	x
	Peer Educators for Health Education	M*	-	5			x	
	Student Clinical Dieticians	33	4.6	152	x	x	x	x
	Peer Educators for Health Education	40	12.0	480	x	x	x	x
	Student Health Service Staff	1	1.0	1				x
	Student Health Service Registered Nurses	1	1.0	1				x
	Health Education	M*	-	3599	x	x	x	x
rvice E	Advisement Center	M*	-	525	x	x	x	x

ıultiple type sign-on was used. Number of students is unknown.

PLATO Group	Descriptive
University Service (cont.)	
ACENTER	Access Cen
BSN	Nursing Re

PLATO Group Descriptive

University Service (cont.)

UDGAMING Group for

Course Symbol by Subject

Descriptive T

Agriculture

APS 133

Anatomy &

Domestic An

Course Symbol
by Subject

Descriptive

Chemical Engineering (cont.)

CHE 432

Chemical E

Analysis

Course Symbol
by Subject

Descriptive T

Computer and Information Sci

CIS 105 . General Com

Course Symbol by Subject	Descriptive Ti

Education (cont.)

Course Symbol
by Subject

Descriptive T

Geology

GEO 467

Geological W

Course Symbol by Subject	Descriptiv
Languages	
ML 666	Modern L

Microcomputer Usage in Credit Courses (continued)

ol	Descriptive Title	Number of Credit Hours	Computer	Number of Students	Average Hours of Use per Student	Total Contact Hours	Time of Utilization Sum.	Fall	Win.	Spr.
	Material Science for Engineers	4	IBM PC	25	1.1	28				x
dies	Museum Curatorship and Temporary Exhibits	3	Macintosh	9	11.4	103				x
	Computing in Music	3	#	17	13.2	224		x		
	Computer Literacy for Musicians	3	Apple II IBM PC	12	83.3	1000	x			
	Societal Context of Nursing	3	Apple II	124	2.0	248				x
	Determinants of Wellness	10	Apple II IBM PC	208	1.5	310		x		
	Restorative Nursing Practice I	10	Apple II IBM PC	94	2.1	197				x
cation	Personal Computers in Health, Physical Education, and Recreation	3	IBM PC	45	33.8	1521		x		x
	Special Problems	3	IBM PC	4	33.0	132		x		
	Sensation & Perception	3	Apple II	10	2.5	25				x
	Cognition	3	Apple II	80	3.5	280		x		x

used are Apple II, Atari 800, Commodore 64, and IBM PC.

PART IV: Microcomputer Usage in Non-Credit Courses

	Descriptive Title	Computer	Number of Students	Average Hours of Use per Student	Total Contact Hours	Time of Utilization Sum.	Fall	Win.	Spr.
ducation	Introduction to BASIC	Apple II	15	12.0	180		x		
	Introduction to Personal Computers	Apple II IBM PC Macintosh	210	7.2	1512		x		x
	Introduction to Wordstar	Apple II	15	12.0	180		x		
Service	Association for Computers in Education	Apple II Macintosh	M*	-	360	x			x
OL	Governor's School for Excellence	Apple II	20	2.5	50	x			
	Community Public Hours	Apple II	M*	-	129	x	x		
	Upward Bound	Apple II	80	8.0	640	x			
	4-H Program	Apple II	60	6.0	360	x			
ervice	Demonstrations	#	M*	-	846		x	x	x
	Latin Skills Package	Apple II	2	11.5	23		x		
	National Science Foundation	Apple II	60	2.0	120	x			
URS	University Open Hours	#	M*	-	11457	x	x	x	x

s used are Apple II, Amiga, Atari 800, Commodore 64, IBM PC, and Macintosh.

nultiple type sign-on was used. Number of students is unknown.

Microcomputer Usage in Non-Credit Courses (continued)

Descriptive Title	Computer	Number of Students	Average Hours of Use per Student	Total Contact Hours	Time of Utilization Sum.	Fall	Win.	Spr.
ervice (cont.)								
Miscellaneous Use	#	M*	-	1500	x	x	x	x
PLATO Use on an IBM PC	IBM PC	M*	-	118		x		
Curriculum Development Lab	Apple II	164	15.0	2460		x		x
Reading Study Center	Apple II	100	4.0	400				x
Reading Study Center Weekend Program	Apple II	14	6.2	87				x
Lesson Design	Apple II Macintosh PLATO	29	3.1	90	x			
Word Processing	Apple II IBM PC	M*	-	2272	x	x	x	x
Writing Center	IBM PC	M*	-	350				x

used are Apple II, Amiga, Atari 800, Commodore 64, IBM PC, and Macintosh.

ıltiple type sign-on was used. Number of students is unknown.

Course Symbol
by Subject

Descriptive

Communication

Organization

There are two main components in the organization of educational computing at the University of Delaware, namely, faculty CBI leaders and centralized support staff. A faculty member identified as "CBI Leader" coordinates the setting of priorities and the allocation of resources within each department. OCBI supports student use via part-time student course aides. Research and development projects are supported by teams of part-time student programmers and full-time professionals.

The CBI leader serves as an intermediary between the OCBI staff and the rest of the faculty in the department. The CBI leader coordinates all computer-based learning activities for the department, including evaluation. Most CBI leaders use a peer review process whereby they obtain help from their colleagues in making value judgments. The energy, enthusiasm, and dedication of the faculty constitute an essential factor in the successful implementation of computer-based education at the University. Table 2 contains a list of CBI leaders.

A Faculty Committee on Computer-Based Instruction reviews CBI projects both at the proposal stage and after the first year of development, and it can be asked by the Director of OCBI to review older projects as well. The following faculty members served on this committee during 1985-86:

Michael Arenson, Music
David Barlow, Physical Education
Richard Herr, Physics
James Morrison, Textiles, Design and Consumer Economics
Paul Sammelwitz, Animal Science, Chairperson
Clifford Sloyer, Mathematical Sciences
Ronald Wenger, Director of the Mathematical Sciences Teaching and Learning Center

The charge to this committee reads as follows:

"The faculty committee on Computer-Based Instruction shall review new projects proposed by faculty members for feasibility, soundness of conception and design, and appropriateness to computer-based instructional techniques, and shall report its findings and recommendations to the Director of the Office of Computer-Based Instruction. It shall also review approved projects after one year to determine whether their initial promise is being realized, and it may undertake other reviews at the request of the Director of the Office of Computer-Based Instruction. To the extent that they find possible, the members shall offer advise and counsel informally to less experienced faculty members at their request.

"The committee shall review proposals to the Center for Teaching Effectiveness that involve computer-based instruction and make recommendations for support to the Associate Provost for Instruction."

In 1984-85, the committee was also charged with conducting a comparative study of alternative computer-based educational systems and reporting its findings to the provost with a recommendation as to whether and in what form the University should continue or replace its mainframe PLATO system. The committee completed its 22-page report in the spring of 1986.

The report begins with a brief history of CBE at UD and points out that one of the most popular features of the PLATO system--its personal and group notes communication capabilities--was not listed as a system selection criterion by the committee that recommended PLATO in 1974 (see "History and Development"). As courseware delivery shifts from mainframes to micros, the need for users to communicate

Table 2

CBI Leaders at the University of Delaware

Departments	CBI Leaders
Accounting	Jeffrey Gillespie
Advisement Center	Peter Rees
Agriculture	Paul Sammelwitz
Anthropology	Juan Villamarin
Art	Raymond Nichols
Art Conservation	Joyce Hill Stoner
Chemical Engineering	Stanley Sandler
Chemistry	John Burmeister
Civil Engineering	Robert A. Dalrymple
Continuing Education	
Access Center	Ed Kepka
Microcomputing	Judy Short/Richard Fischer
Counseling	Richard Sharf
Economics	Charles Link
Education	
Instruction	William Moody
Research	Victor Martuza/Richard Venezky
English	George Miller
Geography	Tom Meierding
Geology	John Wehmiller
Honors Program	Katherine Kerrane
Human Resources	James Morrison
Languages	Gerald Culley
Library	Carol Parke
Life and Health Sciences	David Sheppard
Mathematics	Ronald Wenger
Museum Studies	Bryant F. Tolles, Jr.
Music	
Aural Skills	Fred T. Hofstetter
Written Theory	Michael Arenson
Nursing	Madeline Lambrecht
Physical Education	David Barlow/James Kent
Physics	Richard Herr
Political Science	Richard Sylves
Psychology	James Hoffman
Small Business Development Center	David Park
Statistics	Victor Martuza
UD English Language Institute	Scott Stevens
University Parallel Program	Jay Gil
Urban Affairs	Jeffrey Raffel
Wellspring Health Education	Paul Ferguson
Writing Center	Marcia Peoples

continues, as does the requirement of centralized record keeping for educational research and instructional management. In a review of OCBI's Five-Year Plan, the committee concludes that "The future looks bright for computer-based instruction at the University of Delaware but there are some problems to be solved."

Seven Problems

The second section of the report identifies and discusses seven problems:

1. Continued Reliance on the CYBER 174. Although the University of Delaware PLATO mainframe is an "old" machine purchased in 1978, its reliability is high and maintenance costs reasonable. Noting that the system can be run until 1995 without need for replacement, the report states that ". . . the University appears to have 'lead time' of several years before a decision is required for . . . obtaining another mainframe."

2. Widespread Presence of Microcomputers in the University Community. The report recognizes the need to link instructional microcomputers ". . . to a network of some kind."

3. Continued Utilization of Existing CBE Software. The committee notes that more than 90% of Delaware courseware is written for the mainframe PLATO system and that the University must provide ". . . TUTOR support for as long as its faculty use such software with significant numbers of students."

4. Incompatibility of Current Hardware on Campus. At present, separate networks and computer classrooms are used to deliver academic computer services and computer-based instruction. While progress has been made on configuring a common workstation, the committee notes that ". . . it will take at least two years to determine how to implement a network on the ACS machines that can provide the file-serving, communications, and student record-keeping services that PLATO currently provides."

5. Maintaining a Comprehensive and Versatile Authoring Language During the Transitional Period. The report notes that Control Data's moving TUTOR into a C environment appears ". . .to provide the best collection of graphics and judging commands of any computer-based instructional language. These versions of TUTOR may serve as an effective bridge between the short-term and long-term software development needs of the faculty."

6. Data Collection for Instructional Evaluation. The Delaware faculty relies heavily upon PLATO's ability to save student performance data. The report states that "the system of choice must be capable of accumulating this type of data quickly and accurately."

7. Developing Educational Products for Commercial Considerations and/or Academic Pursuits. There is debate among the faculty as to the primary focus for OCBI in the near and distant future. Should the focus be (1) performing research on how students learn and evaluating the impact of software on learning, or (2) developing educational products for commercial release? How much resource should be devoted to the home interconnect project, which seeks to provide PLATO access to Delaware citizens off campus?

Alternatives

The third section of the report identifies alternatives available for authoring and delivering CBE. Four criteria are listed for evaluating an alternative system:

1. Is its authoring environment as good as PLATO's?

2. Does it provide desirable features, such as transportability, which the PLATO system lacks?

3. Can the University of Delaware move to it without unacceptable trauma?

4. How transportable will materials developed on it be?

After discussing the relative merits of developing courseware in BASIC, PILOT, SuperPILOT, C, LISP, Prolog, COURSEWRITER, DAL, TenCORE, and TICCIT, the committee finds the following:

1. None of them provides all of the features of our present PLATO system.

2. None of them provides a library of courseware which is in any sense comparable to that available on our present system.

3. None of them (with the possible exception of DAL) has the software "hooks" and hardware capability to support LISP-type languages and bit-mapped graphics.

4. Adoption of any of them as a replacement for the CYBER would result in the loss of thousands of hours of CBE courseware now in use. Some of this courseware might be converted to a system like TenCORE, but it would not be a trivial task.

The committee finds that there are three main PLATO alternatives for the future of CBE at Delaware:

1. The C-based TUTOR Environment being developed by Control Data

2. Colossal PLATO, which is being developed at the University of Illinois and will use satellites to connect many thousands of new, low-cost, intelligent PLATO terminals to a large central computer at CERL

3. CMU Tutor, which is being developed in C with UNIX tools under the Andrew environment at Carnegie-Mellon University

Goals

Before making a recommendation, the committee considered the general goals for computer-based education at Delaware and the national niche Delaware should fill. The goals stated by the report include the following:

1. Continue the implementation and evaluation of traditional CAI for remedial, mainline, and enrichment instruction.

2. Encourage faculty members to participate in the creation of computer-based learning materials for their own use in teaching.

3. Serve as an on-campus clearinghouse that helps faculty members select, evaluate, and deliver CBE materials to students.

4. Support faculty interest in educational research by providing an environment in which student data can be conveniently collected and statistically analyzed.

5. Provide leadership in the exploration, application, and demonstration of new technologies and innovative uses of computers, such as interactive videodisc, computer-based multi-media classroom presentations, and data acquisition in science laboratories.

A National Niche

A discussion of the national niche for Delaware's work with computer-based instruction led to ten corollaries that are summarized as follows:

1. Instead of duplicating high-end research being conducted at institutions like CMU, Stanford, and MIT, Delaware should serve as a "filter" of powerful AI principles and methodologies that can be included in the design of educational software and delivered to students within five years.

2. Basic research into cognitive science and other areas that have significant implications for the design of instruction should be encouraged and supported.

3. Some high-end development projects should be supported, but their purpose should be primarily to provide faculty and staff the opportunity to learn about the new techniques and not to produce marketable products.

4. The artificial distinctions between the use of the computer as a tutor and a tool are archaic and should be eliminated.

5. OCBI's authoring environment must provide the "software hooks" needed to link C-based TUTOR programs to procedures written in Pascal, LISP, and Prolog.

6. There must be a strong systems group that provides and supports a flexible and powerful authoring environment for Delaware projects.

7. While these aspirations will apply to all disciplines in which there is serious and sustainable faculty interest, the number of sophisticated, prototypic efforts mentioned in corollary (3) will be limited.

8. Priorities for high-end projects should favor departments whose faculty are committed to long-term research, refinement, and instructional use of the materials.

9. The environment must support extensive on-line data collection and protocols of student interaction to support research, development, and refinement.

10. While commercial development is not the primary emphasis of the niche outlined here, success may occasionally lead to opportunities for the faculty, staff, and University to accept the risk and expense of developing commercial products. Such projects should be administered separately and budgeted on a cost-recovery basis.

Recommendations

The report concludes with a list of short-term and long-term recommendations in the areas of hardware, courseware, authoring environments, and physical environments. The recommendations are summarized as follows.

Hardware Recommendations

Short Term

Retain the CYBER 174 PLATO mainframe as the host of the primary University of Delaware CBE network through 1989.

Develop an IBM PC access disk that incorporates a mouse to substitute for the touch panels on PLATO terminals.

Connect the CYBER to the University's port selector to facilitate electronic mail, student record keeping, and data transfer.

Connect PLATO notes to BITNET so CBI users can send and receive electronic mail via the University's IBM and VAX mainframes.

Use the PLATO mainframe to provide an excellent campus-wide electronic mail service.

Enter into a cooperative agreement with CMU to serve as a development site for testing the instructional applications of high-end workstations and alternative authoring languages.

Long Term

Replace the CYBER 174 with a system that will deliver the instructional computing power and the record-keeping capabilities needed in the decade ahead. Alternatives include the following:

1. Families of high-end workstations
2. New mainframe computers (CYBER, VAX, IBM, etc.)
3. Colossal PLATO (University of Illinois)
4. Internet of local area networks of personal computers
5. PC-DOS software running in a UNIX window

Courseware Recommendations

Short Term

Maintain access to the PLATO courseware library; this requires continued use of the CYBER for the present.

Expand access to microcomputer courseware by (1) having OCBI serve as an on-campus clearinghouse, (2) encouraging faculty to form discipline-based special interest groups for educational computing, and (3) assisting faculty in obtaining permission to modify existing software to meet their needs.

Discourage courseware development in classical TUTOR; to the extent possible, write new materials in a language that can run on both mainframe and microcomputers, either unaltered or with minimal modification.

Establish a procedure by which interested faculty members will be able to develop specific courseware for their own courses on their own microcomputers and deliver it with student record keeping on Local Area Networks (LANs) or mainframes.

Long Term

Encourage faculty members to develop software that uses the computer both as a tutor and as a tool.

Identify and support projects that show promise of applying the results of AI research to instruction.

Authoring Environment Recommendations

Short Term

Develop specifications for a C-based authoring environment that will be equal or superior to TUTOR and compatible with emerging hardware.

Maintain a strong systems staff capable of helping faculty members adapt the most appropriate language to meet their needs.

Expand OCBI's approach to courseware development by initiating a support structure for faculty who wish to program their own educational software outside the RFP process.

Long Term

Provide a high-powered, robust, user-friendly authoring environment that will encourage increased cooperation of faculty members in courseware development.

Include in the authoring environment support for evolving videodisc technology.

Physical Environment Recommendations

Short Term

Work with the scheduling office to allow faculty members to reserve classrooms equipped with computer-based media, including videodisc.

Continue the close working relationship between OCBI, IRC, and ACS in equipping more classrooms with computer-based media.

Long Term

Increase the number of classrooms that contain computer-based audiovisual aids; all new construction should contain the necessary wiring.

Increase the number of microcomputer laboratories in which faculty members can teach class with each student seated at a workstation.

Apply videodisc technology both to self-paced, individualized instruction and to classroom/lecture situations.

When the Delaware PLATO Project began in 1974, the total staff was comprised of three graduate students. As the number of faculty requests for courseware development increased, so also did the size of the staff. When the PLATO system was purchased in 1978, the OCBI staff consisted of 19 full-time and 27 part-time employees. By 1982, it had grown to 55 full-time and 138 part-time staff. In 1986, at the time of the writing of this report, OCBI has 55 full-time staff--one director, two associate directors, one assistant to the director, one office coordinator, four secretaries, one clerk typist, one records clerk, two ICAI specialists, eight professionals in managerial roles, two systems programmers, one peripheral design engineer, three technicians, and twenty-eight professionals with applications and support responsibilities--and 118 part-time staff, most of whom are student programmers. In 1985-86, the secretarial staff was reorganized under the assistant to the director and expanded to include an office coordinator, a records technician, and a clerk typist.

As the staff grew, a management structure evolved. Figure X shows the organizational chart. The director of OCBI reports to the Provost and receives recommendations from the faculty advisory committee. The Office of Computer-Based Instruction consists of five main components, namely, operations, sites, user services, research, and campus program development. Table X lists the OCBI staff. The numbers in column three identify each staff member in the task assignment chart given in figure X. This chart shows which staff members are responsible for carrying out the varied activities in the five components of OCBI.

Operational duties include the running of the Delaware PLATO system and OCBI's VAX mainframe; the management of files such as instructional programs, utility routines, and workspaces in computer memory; maintenance of terminals, microcomputers, and peripheral equipment; data storage and transfer from PLATO to VAX and IBM mainframes and vice versa; printing of graphic displays, program codes, and data files as requested by users; programming of utility routines; on-line and off-line cataloging of lesson materials available on the Delaware PLATO system; maintenance of PLATO data communications and hardware; diagnosis of needed improvements in CYBER software; and research and development of new and existing equipment to enhance OCBI services, such as music synthesizers, microprocessor interfaces, and networks.

Each site is overseen by an OCBI staff member who insures that the physical environment is safe and conducive to student learning. The site director also insures that the terminals do not use more than their proper allocation of computer resources. To date, PLATO sites have been established in the Willard Hall Education Building, Smith Hall, Drake Hall, Purnell Hall, Amy E. du Pont Music Building, the OCBI office in Willard Hall Education Building, the OCBI Annex at 42 East Delaware Avenue, the Academic Advisement Center, Agriculture Hall, Career Planning and Placement, the Center for Counseling, the CIRCLe Office, the Computing Center, Continuing Education, Educational Research, the Health Center, the Honors Center, the Languages Laboratory, Nursing, Physical Education, the Preschool Laboratory, the Reading Study Center, the University of Delaware English Language Institute, the University Parallel Program in Georgetown and in Wilmington, and the Writing Center. Since 1981, OCBI has established fifteen microcomputer classrooms and development labs including an Apple classroom in Willard Hall Education Building, an Atari and IBM PCjr classroom in the Amy E. du Pont Music Building, IBM PC classrooms in Chemical Engineering and in Mechanical Engineering, Apple sites for the College of Education's Curriculum Development Lab and Reading Study Center, a microcomputer demonstration site plus Apple and IBM PC development labs in Willard Hall Education Building, and an IBM PC site in the Writing Center. In addition, a classroom of GIGI terminals connected to OCBI's VAX was opened in 1985.

In 1985-86, OCBI established a Macintosh site for Museum Studies, opened the Art Macintosh classroom, placed two Xerox 1108 workstations in the CIRCLe office, and opened a joint IBM PC site with Academic Computing Services in Newark Hall. The joint site contains 39 workstations which can run DOS programs or connect via the port selector to the University's mainframe computers, including PLATO.

User support services include training seminars for campus users, especially prospective new authors; workshops and courseware development for off-campus users; CBE institutes for educators; demonstrations for visitors; consulting on programming, instructional design, graphics, and networking; assistance for off-campus users; special programs for pre-college students; instructional utility programs shared by many departments; publication of the ACE Newsletter and OCBI's Summative Report; publication and marketing of courseware for mainframes and microcomputers; and evaluation tools. The CBE library houses microcomputer software used by University students in addition to a representative sampling of commercially available computer-based learning packages for learners of all ages. The library also includes videodiscs, which store up to 54,000 still video frames, thirty minutes of motion pictures, thirty minutes of stereo sound, or 200 floppy disks full of computer programs and data.

Students from forty-seven University departments use OCBI's CBE facilities. A professional OCBI staff member is assigned as a contact for each department to assist faculty in the review, acquisition, and use of CBE courseware for their students. Course instructors are assisted by part-time student aides, who orient the students, enter rosters and curricula into the computer, and assist faculty members in responding to on-line student comments and in administering end-of-the-semester evaluations.

OCBI's research activities are coordinated by CIRCLe, which sponsors colloquia and conferences; maintains a comprehensive library of CBE research materials; and assists faculty members in writing research proposals, evaluating the effectiveness of computer-based instruction, and conducting research in intelligent computer-assisted instruction. More information is contained in the CIRCLe section of this report.

Twenty-six campus development projects and three outside development contracts and grants are managed by members of the project management staff. Each project team consists of a faculty principal investigator, an OCBI coordinator, and one or more programmers and is supported by a project manager who both advises team members as the lessons develop and helps set appropriate goals and target dates.

Figure 4

Organizational Chart

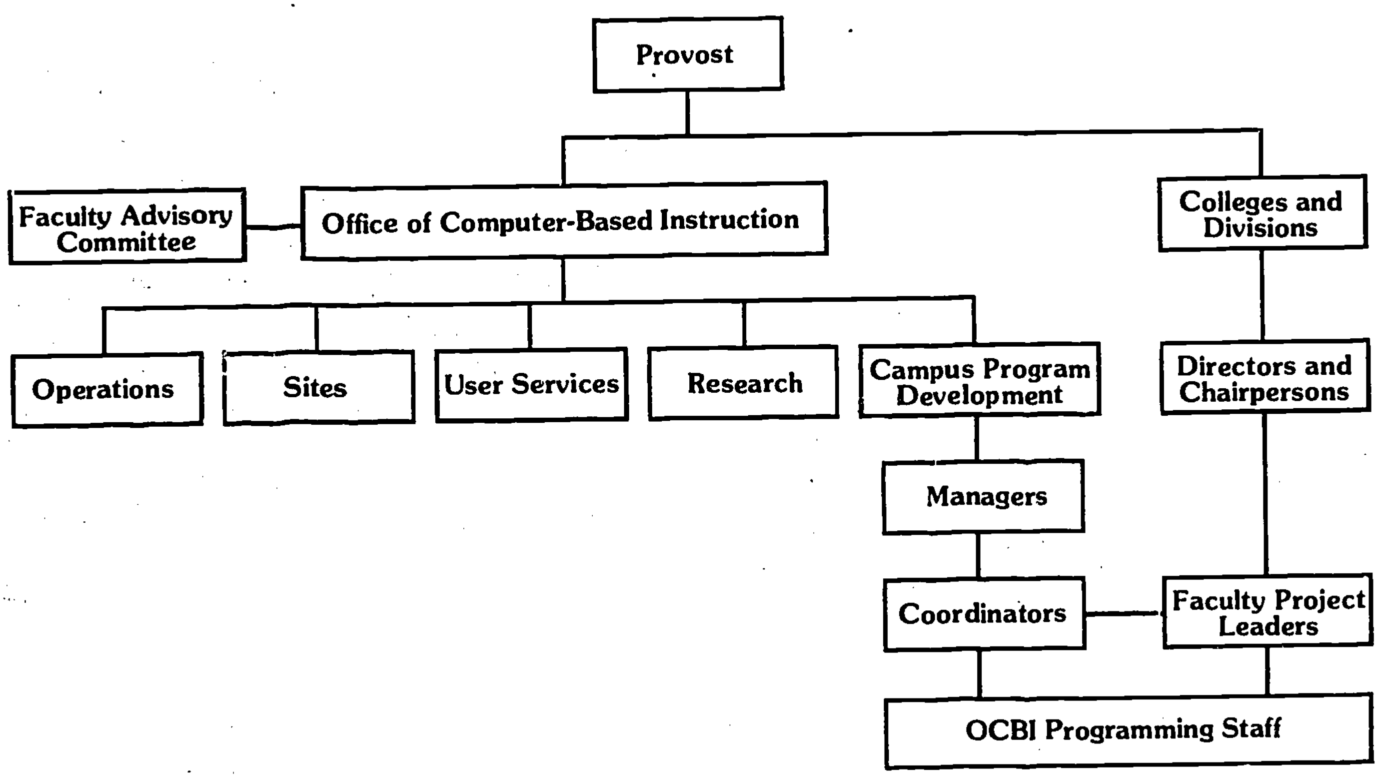

Table 3

Staff of the Office of Computer-Based Instruction

Position	Name	Number
Director	Fred T. Hofstetter	1
Associate Director for Administration	Bonnie A. Seiler	2
Associate Director for Operations	James H. Wilson	3
Assistant to Director for Financial Management	Wilhelmina S. Simms	4
Office Coordinator	Maura B. Jentz	5
Senior Secretary	Charlotte P. Coletta	6
Senior Secretary	Carol-Anne G. Ritter	7
Senior Secretary	Jimmie G. Madison	8
Secretary	Janet S. Harbaugh	9
Clerk Typist	Carol Ivanitch	10
Records Technician	Linda Davison	11
ICAI Specialist	Morris W. Brooks	12
ICAI Specialist	George W. Mulford	13
Manager	Judith Sandler	14
Project Administrator	Roland Garton	15
Project Administrator	Robert Andrew Gilbert	16
Project Administrator	George A. Reed	17
Project Administrator	Mary Jac Reed	18
Senior Systems Programmer/Analyst	David G. Anderer	19
Senior Applications Programmer/Analyst	Steven V. Bertsche	20
Senior Applications Programmer/Analyst	Christine M. Brooks	21
Senior Applications Programmer/Analyst	Jon Conrad	22
Senior Applications Programmer/Analyst	James Hadlock	23
Senior Applications Programmer/Analyst	Carol A. Leefeldt	24
Senior Applications Programmer/Analyst	Evelyn V. Stevens	25
Senior Applications Programmer/Analyst	Dan E. Williams	26
Systems Programmer/Analyst	Shawn Hart	27
Systems Programmer/Analyst	Michael Porter	28
Peripheral Design Engineer	George Harding Jr.	29
Computer Hardware Technician	Linda Everett	30
Computer Hardware Technician	Mark C. Grulke	31
Senior Electronics Specialist	Lankford K. Boyd	32
Applications Programmer/Analyst	Phyllis E. Andrews	33
Applications Programmer/Analyst	Sharon Correll	34
Applications Programmer/Analyst	Gary A. Feurer	35
Applications Programmer/Analyst	Catherine B. Phillips	36
Applications Programmer/Analyst	Deborah E. Richards	37
Applications Programmer/Analyst	Ed Schwartz	38
Applications Programmer/Analyst	Patricia Sine	39
Applications Programmer/Analyst	Rae D. Stabosz	40
Senior Customer Services Specialist	Cynthia Parker	41
Junior Applications Programmer/Analyst	Nancy J. Balogh	42
Junior Applications Programmer/Analyst	Kenneth Gillespie	43
Junior Applications Programmer/Analyst	Paul L. Hyde	44
Junior Applications Programmer/Analyst	Carol A. Jarom	45
Junior Applications Programmer/Analyst	Patrick J. Mattera	46
Junior Applications Programmer/Analyst	John Milbury-Steen	47
Junior Applications Programmer/Analyst	Clella B. Murray	48
Junior Applications Programmer/Analyst	Eric Neufer	49
Junior Applications Programmer/Analyst	D. Jay Newman	50
Junior Applications Programmer/Analyst	Craig Prettyman	51

Table 3 (continued)

Junior Applications Programmer/Analyst	Kathleen D. Troutman	52
Junior Applications Programmer/Analyst	Paige Vinall	53
Junior Applications Programmer/Analyst	Peter A. Whipple	54
Junior Applications Programmer/Analyst	Penny Zographon	55
Graduate Assistant	Kim Hoang	56
Graduate Assistant	David Johns	57
Graduate Assistant	Kent Jones	58
Part-Time Staff*	Marie Ammirato	59
Part-Time Staff	Donata Atkerson	60
Part-Time Staff	Lisa A. Baldwin	61
Part-Time Staff	Deborah Bamford	62
Part-Time Staff	Stacey Bell	63
Part-Time Staff	Dave Bennett	64
Part-Time Staff	Robert Black	65
Part-Time Staff	Jessica Blank	66
Part-Time Staff	Donna Blessing	67
Part-Time Staff	Donald Brill	68
Part-Time Staff	Brian Bulkowski	69
Part-Time Staff	Monique Caron	70
Part-Time Staff	Gwendolyn E. Charles	71
Part-Time Staff	Robert D. Charles	72
Part-Time Staff	Aziz Chowdhury	73
Part-Time Staff	Dorothy Colburn	74
Part-Time Staff	Jeffrey Cotter	75
Part-Time Staff	David Cumbo	76
Part-Time Staff	Anthony D'Ambrosio	77
Part-Time Staff	Joseph Divito	78
Part-Time Staff	Michael Dombrowski	79
Part-Time Staff	Francis J. Dunham	80
Part-Time Staff	William J. Etienne	81
Part-Time Staff	Kathleen C. Fanny	82
Part-Time Staff	Brian Field	83
Part-Time Staff	John Fomich	84
Part-Time Staff	Judi Forman	85
Part-Time Staff	Susan A. Foster	86
Part-Time Staff	Julie E. Frager	87
Part-Time Staff	Terri Francis	88
Part-Time Staff	Sue Garton	89
Part-Time Staff	Katherine J. Godfrey	90
Part-Time Staff	Eric Gould	91
Part-Time Staff	Richard Graper	92
Part-Time Staff	Miriam Greenberg	93
Part-Time Staff	Charles E. Greenman	94
Part-Time Staff	Robert A. Grey	95
Part-Time Staff	Helene Grossman	96
Part-Time Staff	William A. Hance	97
Part-Time Staff	David Handley	98
Part-Time Staff	Kaj Hansen	99

*Part-time staff are miscellaneous wage earners.

Table 3 (continued)

Part-Time Staff*	Alan D. Harbaugh	100
Part-Time Staff	Allen Haughay Jr.	101
Part-Time Staff	Norman F. Hayman Jr.	102
Part-Time Staff	Daniel Herr	103
Part-Time Staff	Brian P. Hogan	104
Part-Time Staff	Curtis Holton	105
Part-Time Staff	Paul Homlish	106
Part-Time Staff	Fred L. Hooks	107
Part-Time Staff	G. Douglas Humphrey	108
Part-Time Staff	Ronald Ih	109
Part-Time Staff	Anand Iyegar	110
Part-Time Staff	Robert C. Jackson	111
Part-Time Staff	Jeff C. Kirk	112
Part-Time Staff	Danine S. Knipe	113
Part-Time Staff	Eric Knospe	114
Part-Time Staff	Lisa Krebs	115
Part-Time Staff	April Lavallee	116
Part-Time Staff	Mary Lavin	117
Part-Time Staff	Anthony O. Leach II	118
Part-Time Staff	Todd Leong	119
Part-Time Staff	Alan H. Levine	120
Part-Time Staff	Cynthia Looby	121
Part-Time Staff	James C. Lynch	122
Part-Time Staff	Tom Masat	123
Part-Time Staff	Douglas R. Mason	124
Part-Time Staff	Suzanne R. McBride	125
Part-Time Staff	David McNeely	126
Part-Time Staff	Yvonne L. Meshreki	127
Part-Time Staff	Richard A. Moore	128
Part-Time Staff	James T. Morgan	129
Part-Time Staff	Leanne M. Musumeci	130
Part-Time Staff	Catherine E. Myers	131
Part-Time Staff	Lee F. Newman	132
Part-Time Staff	James Nicholson	133
Part-Time Staff	Gina Pala	134
Part-Time Staff	Joseph W. Palese	135
Part-Time Staff	Judith Pawloski	136
Part-Time Staff	Greg Pellegrino	137
Part-Time Staff	Daniel C. Pierre-Louis	138
Part-Time Staff	Michael J. Pietrobono	139
Part-Time Staff	Linda R. Prusak	140
Part-Time Staff	Raghu Ramachandran	141
Part-Time Staff	Sean Thomas Ryan	142
Part-Time Staff	Yaprak Saydam	143
Part-Time Staff	Lisa Scott	144
Part-Time Staff	Lisa Sefried	145
Part-Time Staff	Todd Shollenberger	146
Part-Time Staff	Matthew Sienkiewicz	147
Part-Time Staff	Brian Simmons	148
Part-Time Staff	Patricia Sledge	149
Part-Time Staff	Gregory Sloyer	150
Part-Time Staff	Tami Smith	151

*Part-time staff are miscellaneous wage earners.

Table 3 (continued)

Part-Time Staff*	Jeffrey B. Snyder	152
Part-Time Staff	Michael J. Steenkamer	153
Part-Time Staff	Robert Stradling	154
Part-Time Staff	Richard Studley	155
Part-Time Staff	Timothy N. Sweany	156
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Part-Time Staff	Ivy B. Turkington	158
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Part-Time Staff	Susannah Wallenberger	163
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Part-Time Staff	Morris Weinstock	166
Part-Time Staff	Ben E. Williams	167
Part-Time Staff	Lamar Willis	168
Part-Time Staff	David Wolfe	169
Part-Time Staff	Mary M. Wright	170
Part-Time Staff	Maura Young	171
Part-Time Staff	Phillip Young	172

*Part-time staff are miscellaneous wage earners.

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*Joint site with Academic Computing Services

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Geography M17, C45, 102, 104, 112
Geology M17, C42, 53, 55, 126
Languages M13, M14, M17, C21, C39, C47, 34, 37, 50, 51, 52, 53, 55, 67, 86, 118, 128, 131, 170, 172
Library - IBM PC M14, C37
Library - PLATO M14, C37
Life and Health Sciences M14, C24, 46, 74
Math M12, C46, C49, 95, 120, 169
Math Enrichment M16, C39, 83, 133, 150
Museum Studies M16, C55, 25
Music Instruction M16, C20, C22, C54, 101
Music Research M16, C35
Music Videodisc M16, C38, 125
Nursing M16, C25, 80, 82, 93
Physical Education M13, C51, 52
Sociology M17, C53, 55, 127
Statistics M18, C48, C50, 62, 64, 72, 77, 100, 117, 122, 146, 152, 161
Textiles and Design M14, C51

D - Associate Director in Charge; M - Manager in Charge; C - Coordinator of Project

Courseware Development Process

Nievergelt* has pointed out that ". . . it makes no sense to start a CAI project unless one is willing to write most of the necessary courseware." Whereas this is not true for every subject, it was recognized by the faculty committee in 1974 that although good examples of computer-based education could be found in existing program libraries, there were many new applications that needed to be explored, and therefore a heavy emphasis upon program development was planned. Figure 6 shows the present state of the evolution of the Delaware model for courseware development. Using a systems approach, it contains a proposal stage, a planning and design stage, a development stage, a refinement stage, and a standards review stage. It departs from the traditional systems approach in that it does not contain a separate evaluation stage; rather, evaluation is incorporated throughout the model in a variety of feedback loops.

The process begins with the proposal stage, in which the faculty member works with an OCBI staff member to develop a written proposal for courseware development. The proposal addresses the student need that would be met by each lesson; justifies the use of the computer; describes departmental commitment, impact, evaluation, and publication plans; and projects the need for programming and design support. Proposals are reviewed by the Faculty Committee on CBI and the OCBI managers. Some proposals are recommended for funding, while others are referred back to the faculty member for revisions. Once the proposal has been funded, a coordinator and a student programmer are allocated to the new project, forming with the faculty member a development team, which is overseen by a project manager. Where appropriate, several projects targeted for the same computer are assigned to a larger team of professional designers and programmers, plus student programmers. In 1983, two such development teams were formed for the IBM PC and the VAX mainframe. Each multi-project team is made up of a project manager; coordinators for each funded project, who serve as liaison with faculty; an analyst responsible for all code and documentation; plus additional programmers and designers who can be assigned to work on more than one of the projects, shifting assignments as needed.

Since 1983, requests for research and development support by OCBI have been administered by means of a formal Request for Proposals (RFP) process. The first call for proposals in February of 1982 emphasized four program areas: faculty/staff initiation, courseware development, lifelong learning, and research. In 1983, a fifth area was added, namely, Intelligent Computer-Assisted Instruction (ICAI). Videodisc and conversion categories were created in 1985. In all, 135 proposals have been submitted, of which eleven were funded to begin during 1985-86. Proposal titles and principal investigators are listed in Table 4.

During the planning and design stage, the development team plans each lesson in detail and works out the design, display by display, in the form of a paper script. Teams submit the script to a review while ideas are on paper and not yet in the computer, so that suggestions can be incorporated before the costly programming stage begins.

*Jurg Nievergelt, "A Pragmatic Introduction to Courseware Design," IEEE Spectrum, September, 1980, pp. 7-21.

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Table 4

Proposals Funded by [illegible] in 1985-86

Principal Investigator	Department	Proposal Title
Dr. Theodore Braun and Dr. Thomas Lathrop	Languages and Literature	Conversion of French PLATO Lessons to Microcomputer, with New Spanish Version
Dr. Billy Glass and George Reed	Geology OCBI	Space--The Final Frontier
Arthur Hoerl, Dr. Victor Martuza, Dr. John Schuenemeyer, and Mary Jac Reed	Mathematical Sciences Educational Studies Mathematical Sciences OCBI	Ten Additional Statistics Lessons for the VAX Statistics Package
Dr. Janet Johnson	Political Science	VAX Social Science Research Methods Lesson Package
Dr. Vivian Klaff	Sociology	Modules to Teach Demographic Data Processing and Analysis
Dr. Victor Martuza, Arthur Hoerl, Dr. John Schuenemeyer, and Mary Jac Reed	Educational Studies Mathematical Sciences Mathematical Sciences OCBI	Research on the Effectiveness of Computer-Based Statistics Instruction
Linda Matocha	Nursing Science	Prepared Childbirth--An Independent Instruction Package for Nurses
Dr. Julius Meisel	Educational Studies	The Effects of Negative Social Comparisons on the Self Efficacy and Academic Performance of Elementary School Children

Table 4 (continued)

Proposals Funded by OCBI in 1985-86

Principal Investigator	Department	Proposal Title
Bonnie Meszaros	Economic Education	Microcomputer Lessons on Monetary Policy and the Creation of Money
Dr. James Morrison	Textiles, Design and Economics	Home Interconnect Project: The Development of a Support System Resulting in the Effective Use of Household Computers by Children Ages 5 to 7
Dr. Erwin Saniga and Dr. James Butkiewicz	Business Administration Business and Economics	Expert System Applications in Business and Economics

Once the script has been reviewed, the lesson progresses to the development stage. Although the lesson may be coded by a professional programmer/analyst or part-time student programmer, the quality of the code and its documentation are the responsibility of the team's analyst. The design of the lesson is reviewed again as it goes on-line. After the programming is completed, the lesson's code is reviewed in order to improve the programming techniques and the documentation of the lesson.

The principal investigator makes a formal inspection of the lesson at the beginning of the refinement stage, before pilot and large scale use by students. The lesson is further refined as trial use by students and a final design review by OCBI staff provide feedback on its strengths and weaknesses.

After the lesson has been successfully used by a large group of students and is incorporated into a curriculum, it is ready for the standards review stage. Faculty members are encouraged to publish articles about their lessons and to give demonstrations both on and off campus. Each lesson goes through a review of design and programming standards. In these reviews, the lesson and its documentation are checked to make sure that they meet OCBI standards. The final step is the editing of the program description or documentation; the materials are then ready to be published and disseminated.

Publication and Products

As described above in the section on OCBI's Courseware Development Process, the last stage in lesson development includes distribution. After the lessons pass the code and lesson reviews included in the Delaware Model for Courseware Development, copyrights are secured, and the authors document the content and performance of the lessons. When the internal review is completed, the lessons are made available to other institutions.

Videodiscs and peripheral hardware are also produced by the Office of Computer-Based Instruction. After internal review and testing, appropriate copyrights and patents are secured, and the University markets these products itself or through outside vendors.

When the University markets a product, an OCBI Customer Services Specialist works closely with the product's manager to establish time lines, which include the design of product packaging, documentation, and promotional materials. University service units and outside vendors are invoked as appropriate to procure the necessary packaging. Promotion may take many forms, including informational brochures, press releases, magazine and journal advertisements, scholarly papers, and demonstrations by OCBI staff or the Principal Investigator at conferences and conventions and for visiting colleagues.

More information regarding the availability of the University of Delaware's CBI products can be obtained by phoning an OCBI Customer Services Specialist at (302) 451-8161.

Subscription Products

The GUIDO Music Learning System

GUIDO courseware, described in the Music section, is available in mainframe or Micro PLATO versions. Customers obtain the lessons through license agreements. Mainframe customers receive a tape of the package, and cost is based on hourly use. Micro GUIDO customers contract for either a six-month or two-year license and receive one combination instructor/student floppy disk per learning station. The instructor portion can be used to change the content of the instructional units and their required competencies. OCBI will make additional copies for customers who desire one disk for each student. Updates of both mainframe and Micro GUIDO versions are mailed periodically when the GUIDO system is revised.

PLATO Lessons

The PLATO lessons that have been developed at the University of Delaware and have passed the OCBI publication process are available either from the Control Data Corporation or directly from the University of Delaware. Appendix B contains a list of Delaware PLATO lessons published by the Control Data Corporation; they may be obtained by contacting a Control Data sales representative. Appendix C contains a list of lessons published by the University of Delaware. These lessons are licensed by the University. Customers receive a copy of the lesson, and cost is based on hourly use. For more information on these lessons, please refer to the appropriate academic area in Chapter II, "University Applications."

Personal Computer Courseware Products

Latin Skills

The Latin Skills courseware described in the Language section is available for the Apple II+,IIe,IIc and compatible microcomputers. The courseware is available in four versions, each coordinated with a popular Latin textbook. Programs are keyed to the following texts: Latin: An Introductory Course (Wheelock), First/Second Year Latin (Jenney), Latin for Americans (Ullman), Latin via Ovid (Goldman and Nyenhuis), and Ecce Romani (Longman, Inc.; revised edition).

Individualized Latin Curriculum

Individualized Latin Curriculum is a microcomputer-based package which allows classroom teachers to set up individual courses of study in elementary Latin. It is designed to supplement the University of Delaware's Latin Skills package (Wheelock version) and Wheelock's Latin: An Introductory Course.

Individualized Latin Curriculum consists of six audio cassettes, a student syllabus, a teacher's manual, and a test-generator disk. The disk produces tests at twelve levels. Each test is unique because its questions are selected randomly from a separate bank of items for that level. A teacher can use this material to construct a self-paced, individualized curriculum that covers two years of high school Latin or two semesters of study at the college level.

The Individualized Latin Curriculum runs on the Apple II+, IIe, IIc, and Apple-compatible microcomputers with at least 48K of memory, a disk drive, and a printer.

Library Research Skills

Four of the Library Research Skills programs described in the Library section are available for the IBM PC, PC XT, and AT with 128K; the PCjr with 256K; the Zenith Z150; and the OCLC Model 300 terminal. The package includes The Card Catalog, Periodical Indexes, Newspaper Indexes, and Government Document Indexes.

Videodisc Products

Videodisc Music Series

The Videodisc Music Series, described in the Music section, consists of four two-sided discs sold as a package for a one-time fee. The package also includes a manual and printed anthology.

Hardware Products

The University of Delaware Sound Synthesizer

The University of Delaware Sound Synthesizer (UDSS), described in the Music section, was designed to be a product affordable to educational users, yet capable of meeting the needs of music instruction. It comes with a ninety-day warranty. OCBI will handle repairs on a time-and-materials basis should they be needed following the warranty period. Updates of the synthesizer's Read-Only Memory (ROM) chips are sent to customers free of charge as they become available. Synthesizers have been sold to institutions in the United States, Canada, Africa, Australia, and Europe

<u>Instructor and Author Training</u>

Since the installation of the first University of Delaware PLATO terminal, a series of seminars has been offered four times a year in order to provide academic and corporate educators the opportunity to learn about various aspects of computer-based education. Seminars that are not specific to a particular computer system include a general orientation, two courses in lesson design, and a lesson review seminar. For those who want to develop PLATO lessons, there is an orientation for instructors, a sequence of TUTOR programming courses, a programming review seminar, a seminar on special-purpose lesson packages and other topics of current interest, and a seminar on how to program the microcomputer in programmable PLATO terminals. For those who want to specialize in a microcomputer, there is an introduction to instructional microcomputing, two courses in BASIC programming, a course in Pascal, a course in 6502 assembly programming, and a course in Apple lesson design.

Both PLATO and microcomputer seminars are offered free of charge to members of the University of Delaware community. Because of the success these seminars have had in producing competent CBE authors, and in response to the need for a national training program for CBE authors, the Office of Computer-Based Instruction offers the same training curriculum in a revised, modular format of intensive workshops for those outside the University. Participants may select a training period of one or two weeks. One-week registration allows participants to select three modules from the training curriculum; two-week registration allows participants to take five modules. A brochure with more information regarding this training program is available from the Office of Computer-Based Instruction. Tables 5, 6, and 7 list the general CBE modules, the PLATO modules, and the microcomputer modules, respectively.

Table 5

Training Seminars on Computer-Based Education in General

1. <u>Introduction to Instructional Programs on Microcomputers and the PLATO System</u>. General purposes and uses of the PLATO system, the Apple, and other microcomputers. Illustrates special features such as touch-sensitive screens, joysticks, mice, music synthesizers, random-access audio, and speech synthesizers. Helps participants establish comparisons and guidelines for the use of CBE in various fields.

2. <u>Lesson Design</u>. Presents guidelines for designing computer-based educational materials. Emphasizes the advantages and disadvantages of a variety of instructional styles, plus work on basic display techniques, response handling, and individualized instruction.

3. <u>Review and Critique of CBE Lessons</u>. Designed to help authors improve the instructional materials they are developing. Includes the sharing of design techniques and informal review and critique of one another's lessons.

4. <u>Advanced Lesson Design</u>. Addresses four specific problem areas in the design of computer-based educational materials: the appropriate use of light pens, mice, and touch screens; improving student interaction; creating simulations; and making full use of alternate design formats.

Table 6

Training Seminars for PLATO Users and Authors

1. Orientation for PLATO Instructors. Guidelines for integrating PLATO lessons into the participant's learning environment. Topics include viewing the library of instructional materials on the PLATO system, organizing these materials into a curriculum, setting up student rosters, collecting student-usage data, and using the system's communication features. Provides a valuable opportunity to learn how to individualize instruction.

2. Beginning TUTOR Programming. For those with little or no background in computer use. Covers the fundamentals of TUTOR, the language of the PLATO system. Includes guided practice at a PLATO terminal.

3. Advanced TUTOR Programming. For those with some prior knowledge knowledge of TUTOR. Covers advanced topics in programming on the PLATO system. Tailored to participants' individual programming needs.

4. TUTOR Programming Review and Critique. Includes informal review and critique of TUTOR programming techniques used by participants. Lessons are reviewed for readability, documentation, and efficiency.

5. Site Management Training. Designed for those who manage a site on the PLATO system. Emphasizes how to use "site director options" to run an efficient site. Topics include PLATO system hardware components; system resources such as extended memory, disk space, and computer time; and how to allocate resources among users.

6. Computer-Managed Instruction (CMI) on the PLATO System. Designed to teach participants how to use the PLATO Learning Management (PLM) package. Demonstrates the use of the PLATO system for computer-managed instruction. Includes instructor-specified objectives, test items, mastery criteria, and multimedia instructional use. Topics include the use of PLM to individualize instructional programs, create competency-based courses, and set up study/review materials.

7. MicroTUTOR Programming. Introduces participants to MicroTUTOR, the language of the microprocessor in programmable PLATO terminals. Topics include judging, dual processing, conversions, and floppy disks.

Table 7

Training Curriculum for Microcomputer Users and Authors

1. Introduction to Instructional Microcomputers. Components and uses of a typical instructional microcomputer are outlined. Topics include discussion of terminology, operating systems, start-up procedures, and trouble-shooting. Compares the Apple system to other microcomputers and peripherals. All sessions include hands-on experience.

2. Introduction to BASIC. Develops skill in utilizing BASIC statements to produce instructional materials. Intended for those with interest or experience in programming who wish to develop programming skills on a microcomputer. Assumes some familiarity with microcomputer terminology.

3. Advanced BASIC Programming. Emphasizes programming techniques in the BASIC programming language. Covers graphics, color, and the creation of files for data collection. Intended for those who have mastered beginning BASIC.

4. Instructional Programming in Pascal. Emphasizes the editor, modes of display, and the formulation of typical Pascal programming structures. Participants program a small practice lesson of their choice and learn how to obtain information on specific commands from reference manuals.

5. Introduction to Assembly Language Programming. Assembly language instructions and addressing modes of the 6502 microprocessor. Covers hexadecimal arithmetic, logical operators, and the functions of hardware gates.

6. Apple Lesson Design. Techniques of instructional design as applied to the development of programs for the Apple microcomputer. Includes making the design fit the sophistication of the programming language and capabilities of the Apple system, simplifying difficult student input situations, using color wisely, and choosing appropriate function key conventions. Includes a critique of published Apple lessons.

Orientation to Computer-Based Instructional Systems

New users usually begin their orientation to computer-based instructional systems by attending the Office of Computer-Based Instruction's introductory seminars on PLATO and microcomputers. These seminars are followed up by a review of lesson materials.

Potential users may review lessons to consider them for use by students or to provide ideas for new lessons. Ideas for applications in one's own subject can be conceived as a result of looking at lessons in other subjects.

Another early step in becoming acquainted with the features of CBI systems involves trying various accessories such as the random-access audio device, which plays pre-recorded messages; the University of Delaware Sound Synthesizer; the Votrax digital speech devices; the random-access slide projector; interactive videodisc; different types of printers; and input devices such as joysticks, mice, game paddles, light pens, touch panels, and graphics tablets.

OCBI's microcomputer classrooms contain a growing collection of diskettes and manuals that are cataloged according to subject matter and grade level. All of these materials are available for review.

More than 8000 hours of lessons reside on the Delaware PLATO system. The ever-increasing PLATO lesson reference service is organized into twenty-seven subject matter catalogs and is accessible from any PLATO terminal. In addition, comprehensive written guides to lesson materials are available from the Office of Computer-Based Instruction.

In order to facilitate the review of PLATO lessons by faculty, staff, students, and visitors, a special "demonstration" signon has been created which gives all users immediate and easy access to lessons on the PLATO system. Instructions for using this signon are illustrated in figures 7 and 8. First, when you are asked for your name, type "user" as shown in figure 7, and then press NEXT key. Second, when you are asked for your group, type "demo," as shown in figure 8, and then hold down the SHIFT key while pressing the STOP key. An index will appear that provides access to most of the instructional materials on the PLATO system. This index is shown in figure 9. Reviewers may try a lesson by typing the appropriate letter from the index.

Four PLATO lessons have been written specifically for the purpose of orienting new users to the Delaware PLATO system. They include "How to Use PLATO," which shows how to operate the terminal; "Seminars Offered by the Office of Computer-Based Instruction," which describes the seminar series offered four times a year by OCBI; "Information About OCBI," which displays tables and graphs on monthly terminal use, projected costs, and departmental involvement; and "Delaware PLATO System Hardware Configuration," which describes the PLATO system, communications equipment, and terminals. These four lessons are accessible from the demonstration index.

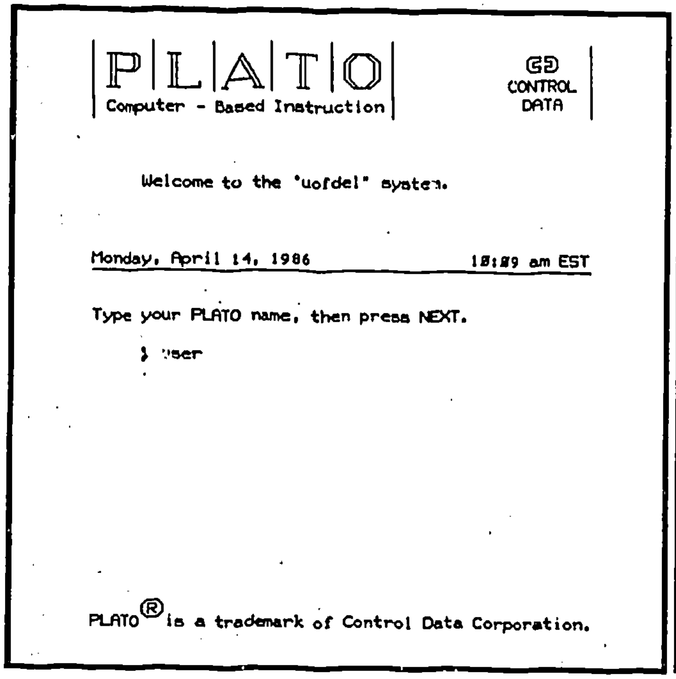

Figure 7. Signing on for Lesson Review: The Name.

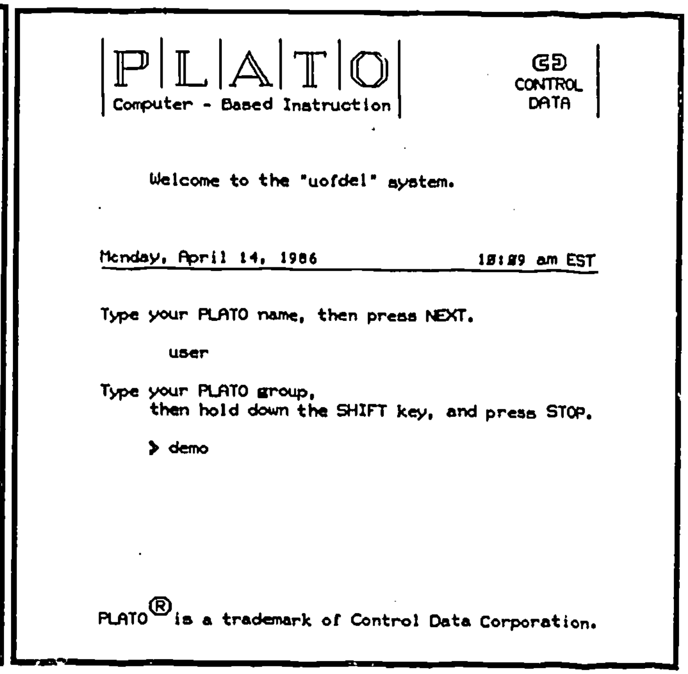

Figure 8. Signing on for Lesson Review: The Group.

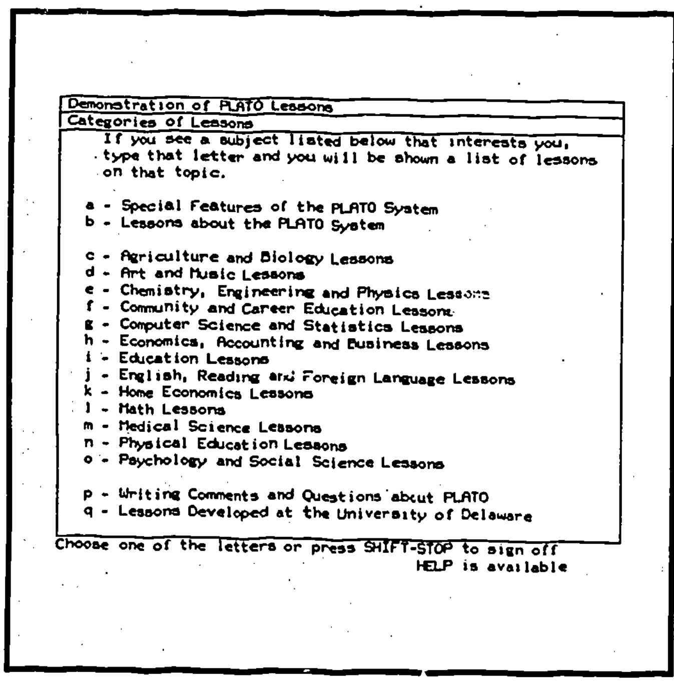

Figure 9-A. Index of Programs for Lesson Review.

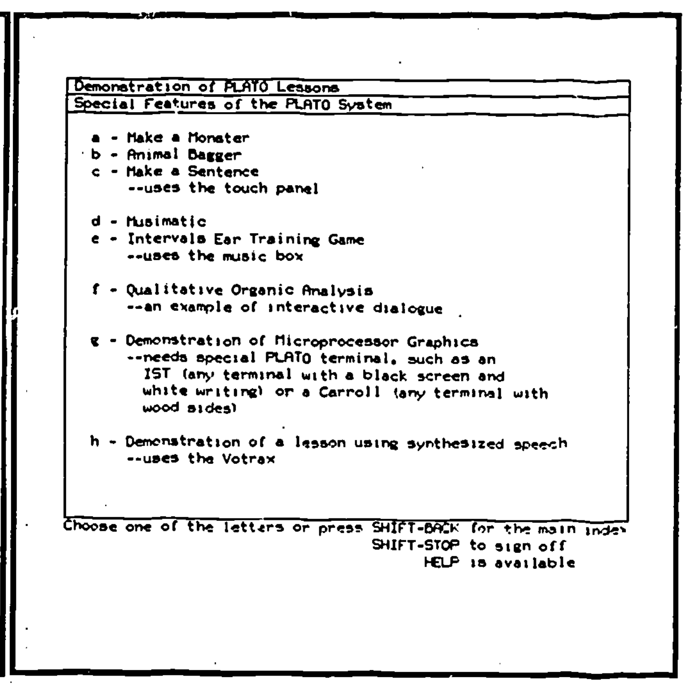

Figure 9-B. Index of Programs for Lesson Review.

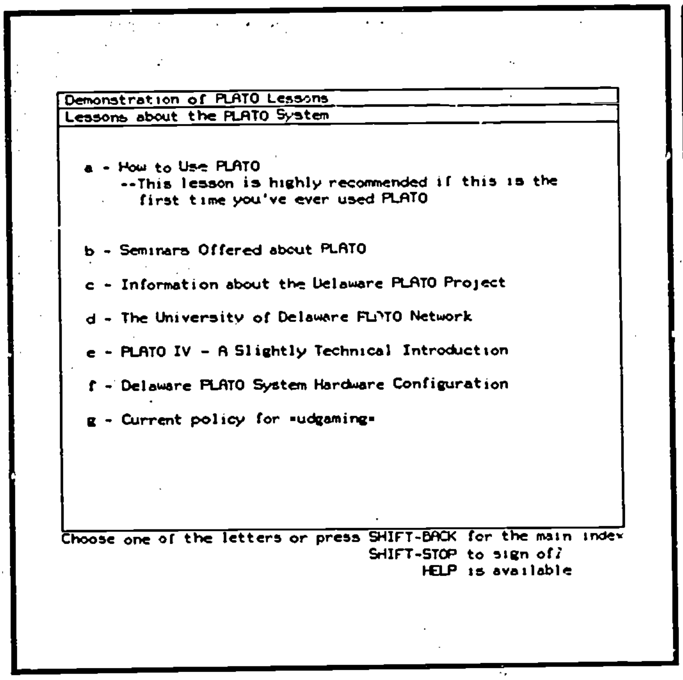

Figure 9-C. Index of Programs for Lesson Review.

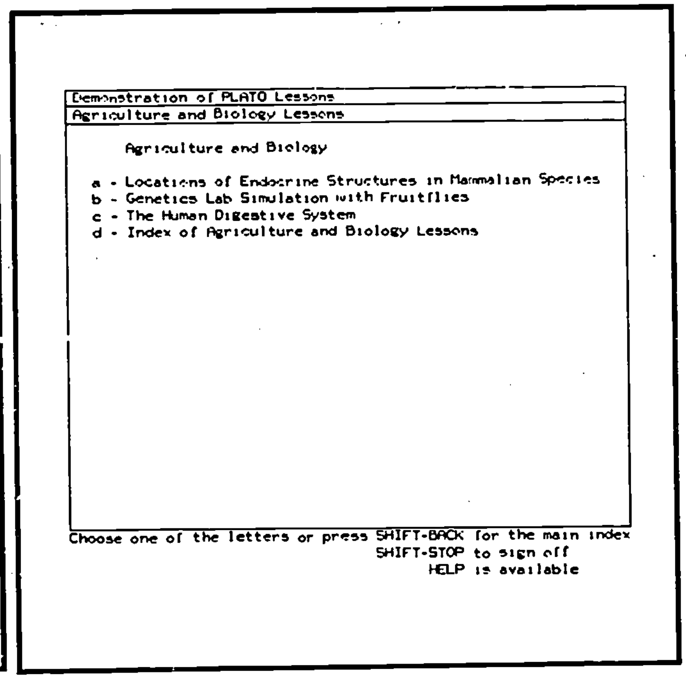

Figure 9-D. Index of Programs for Lesson Review.

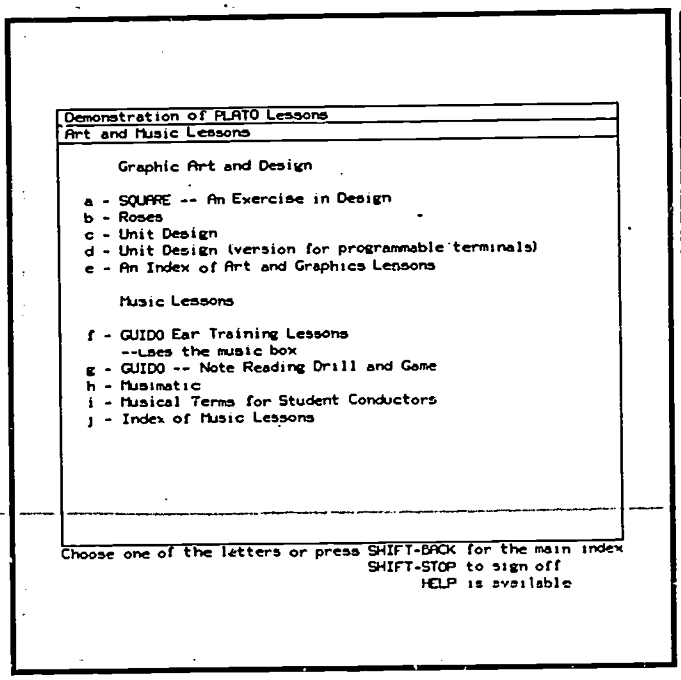

Figure 9-E. Index of Programs for Lesson Review.

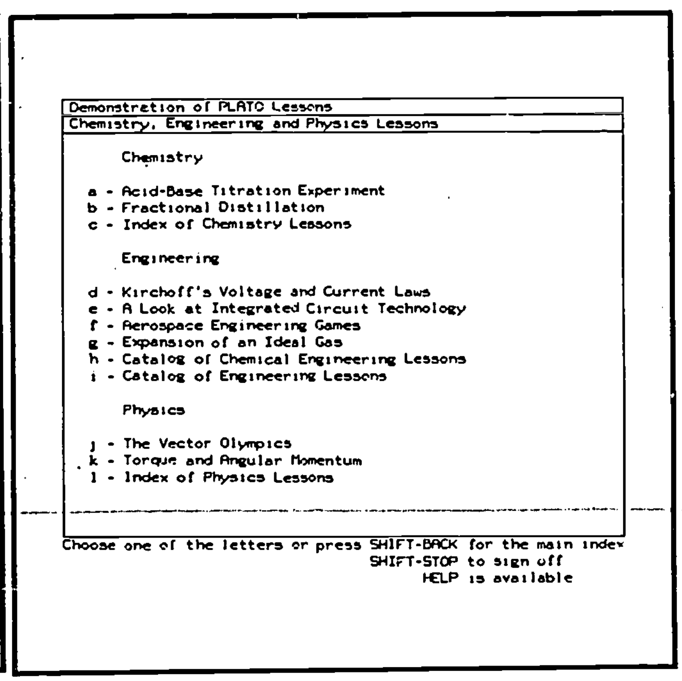

Figure 9-F. Index of Programs for Lesson Review.

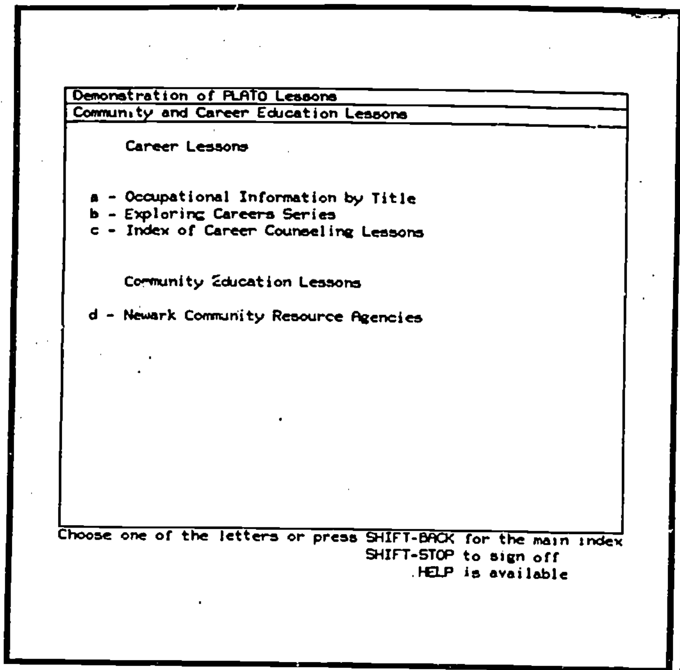

Figure 9-G. Index of Programs for Lesson Review.

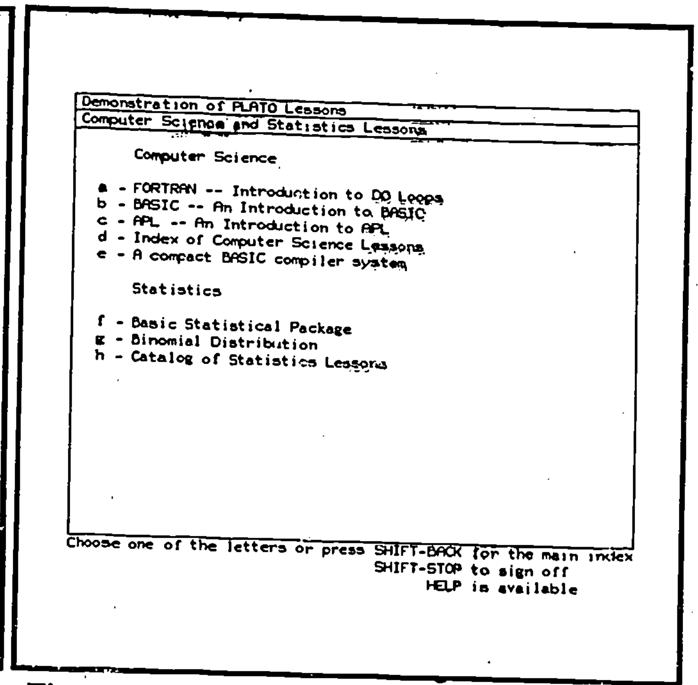

Figure 9-H. Index of Programs for Lesson Review.

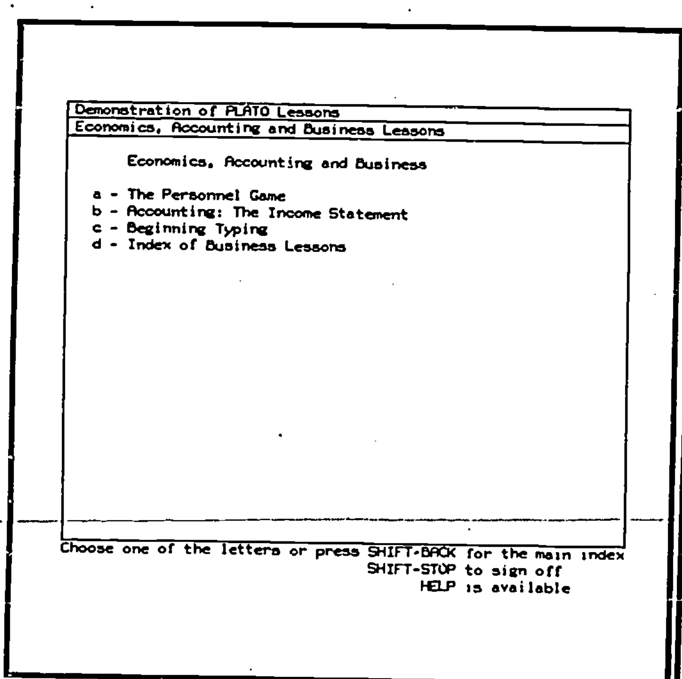

Figure 9-I. Index of Programs for Lesson Review.

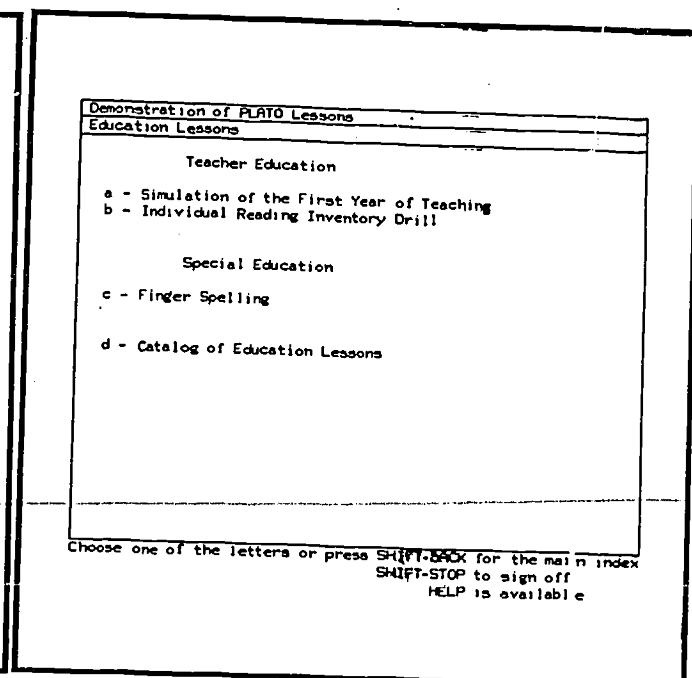

Figure 9-J. Index of Programs for Lesson Review.

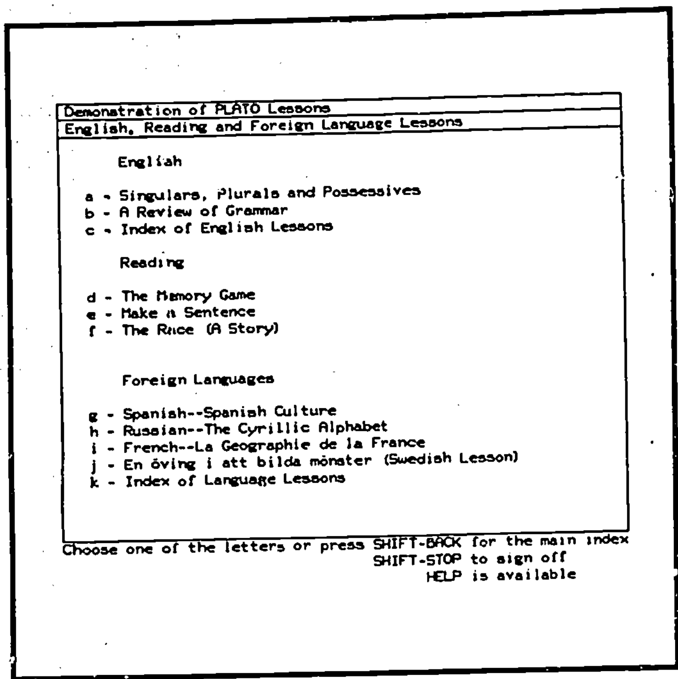

Figure 9-K. Index of Programs for Lesson Review.

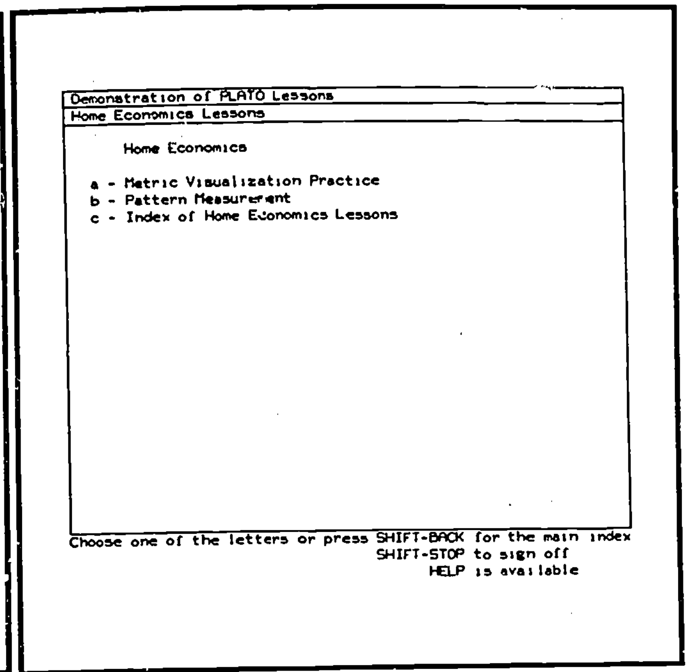

Figure 9-L. Index of Programs for Lesson Review.

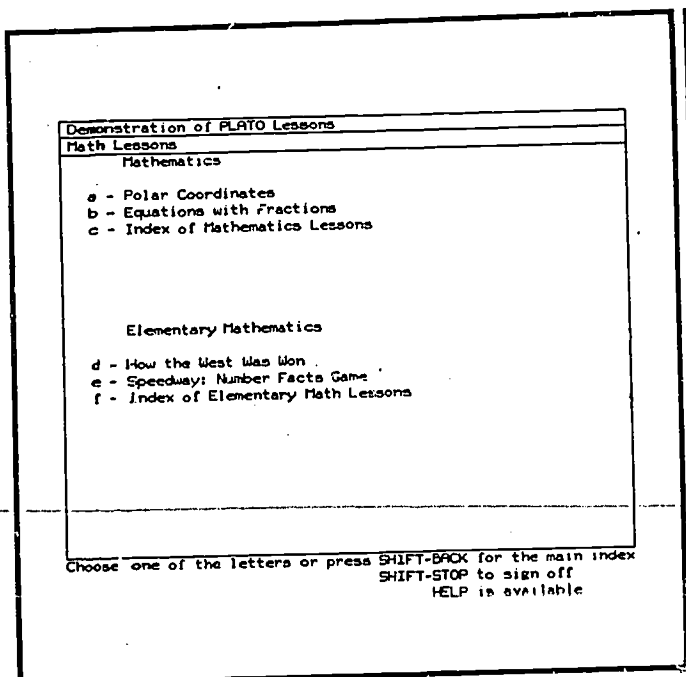

Figure 9-M. Index of Programs for Lesson Review.

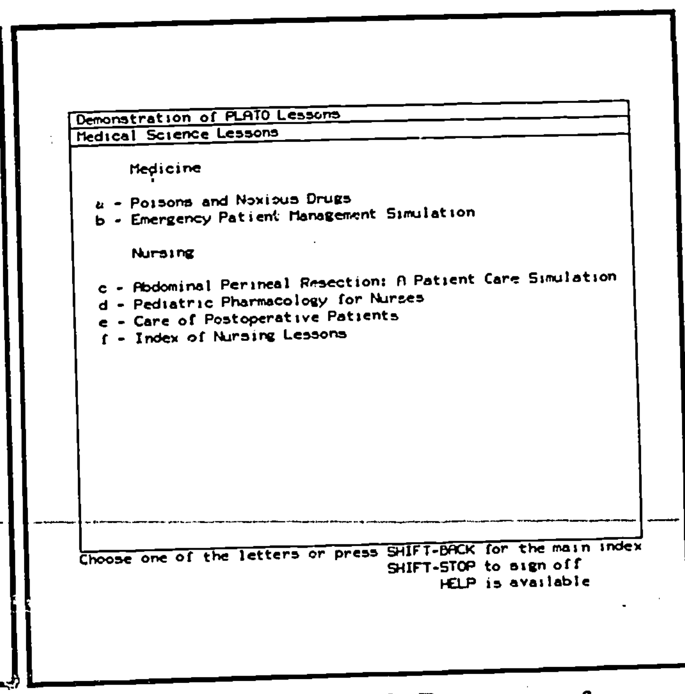

Figure 9-N. Index of Programs for Lesson Review.

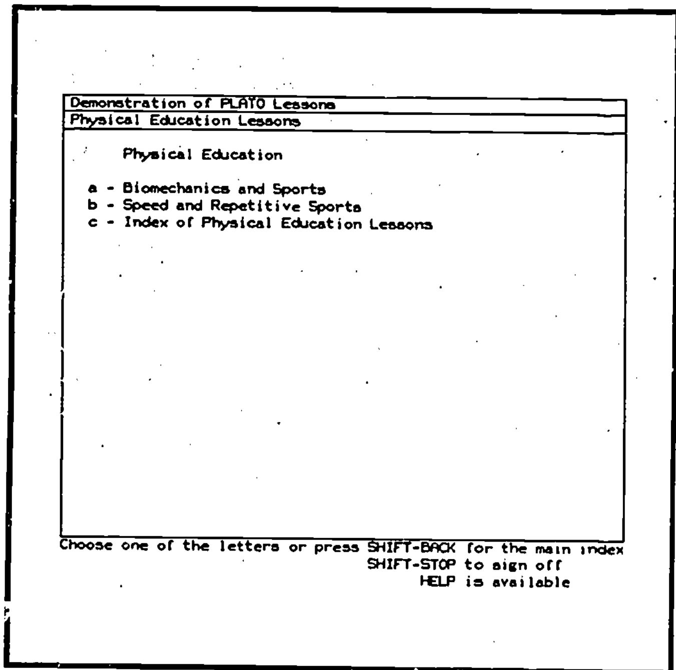

Figure 9-O. Index of Programs for Lesson Review.

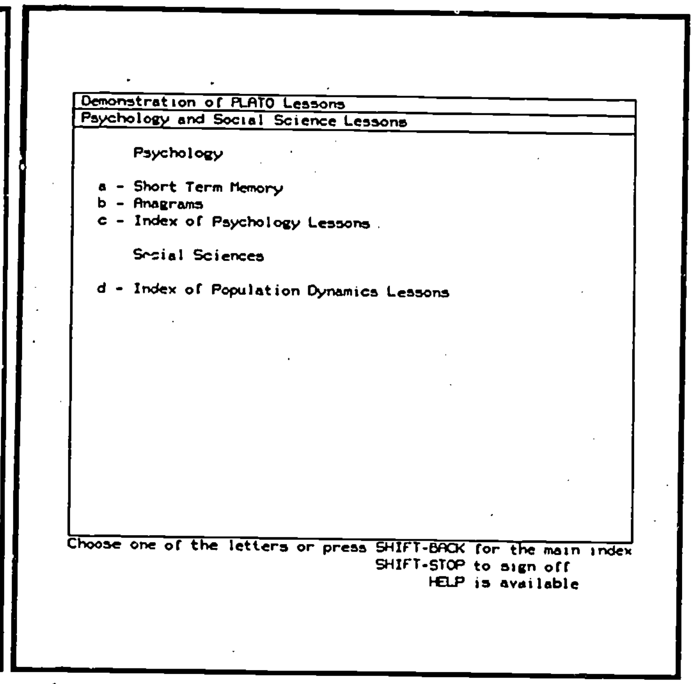

Figure 9-P. Index of Programs for Lesson Review.

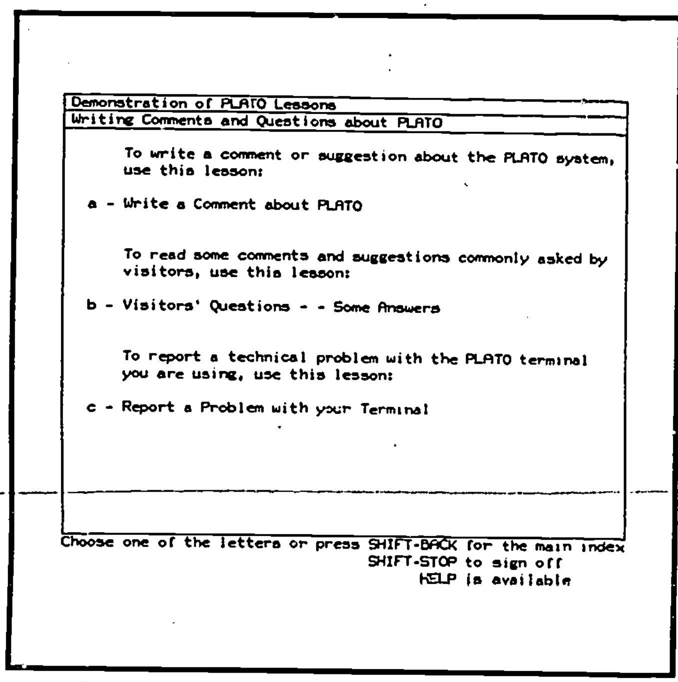

Figure 9-Q. Index of Programs for Lesson Review.

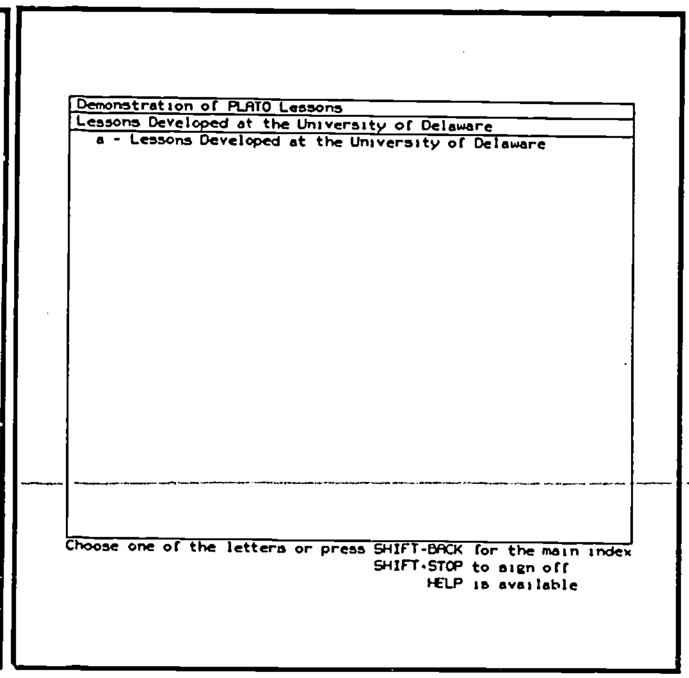

Figure 9-R. Index of Programs for Lesson Review.

Participation in Conferences

The University of Delaware is an institutional member of the Association for the Development of Computer-Based Instructional Systems (ADCIS) and the Association for Educational Data Systems (AEDS), the two primary forums for the scholarly exchange of ideas regarding computer-based education. Over the years, many faculty and staff have served as officers, and the University has formed several special interest groups.

Within ADCIS, the University of Delaware founded the Music, Mathematics, Home Economics, and Theory and Research interest groups. The University also formed a local chapter of AEDS. Originally called Greater Delaware AEDS, the chapter changed its name to the Association for Computing in Education (ACE) in 1985.

In addition to participating in ADCIS and AEDS, University faculty and staff have delivered papers at many national and international conferences. Table 8 contains a list of presentations made during 1985-86.

Table 8

Conference and Workshop Presentations
by University of Delaware Faculty and Staff
During 1985-86

Arnott, Patricia. 1986. Harnessing Today's Technology: A Computer-Assisted Instruction (CAI) Approach. Annual Conference of the American Library Association, New York, New York, June 29.

Arnott, Patricia. 1985. Library Instruction and the Computer: Making the Most of the New Technology. New York Library Association, New York, New York, December 9.

Aljadir, Leta P. and Evelyn V. Stevens. 1986. The Computer as a Tutor in Dietetic Education. Area VI DEP/COE Regional Meeting, Wilmington, North Carolina, April 3-4.

Arena, Louis and Tom Sicoli. 1985. CBE for the Multiply/Severely Handicapped. Fall Conference of the Association for Computers in Education, University of Delaware, Newark, Delaware, November 9.

Arenson, Michael and Gary A. Feurer. 1986. A Rule-Based Harmony Expert: The First Step to an Intelligent Harmony Coach. 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, New Orleans, Louisiana, February 3-6.

Arenson, Michael A. and Fred T. Hofstetter. 1986. Controlled Evaluation of a Mainline Music Learning System. Faculty/Staff Retreat on Research in Computer-Based Learning, University of Delaware, Newark, Delaware, February 10.

Bear, George G. 1986. Issues in the Evaluation of Computer Literacy Programs. Faculty/Staff Retreat on Research in Computer-Based Learning, University of Delaware, Newark, Delaware, February 10.

Culley, Gerald R. 1985. Dealing with Student Errors: Diagnostics and Review. Practicum on Computing in Undergraduate Language Studies, Gettysburg College, Gettysburg, Pennsylvania, July 14-17.

Culley, Gerald R. 1985. Database Techniques for CAI: LECTOR. Pennsylvania Classical Association, Harrisburg, Pennsylvania, October 10.

Culley, Gerald R. 1986. Improving CALL Before It's Too Late. Symposium on Computers and the Humanities: Today's Research, Tomorrow's Teaching, University of Toronto, Toronto, Ontario, April 15-18.

Culley, Gerald R. 1986. LECTOR: Student-Controlled CAI. Classical Association of the Atlantic States, University of Maryland at College Park, College Park, Maryland, April 19.

Herr, Richard B. 1986. Use of Microcomputers for Data Acquisition in Science Labs. Fall Conference of the Association for Computers in Education, University of Delaware, Newark, Delaware, November 9.

Hoffman, James E. 1986. Intelligent Computer-Assisted Instruction: A Tutorial. Faculty/Staff Retreat on Research in Computer-Based Learning, University of Delaware, Newark, Delaware, February 10.

Table 8 (continued)

Hofstetter, Fred T. 1985. Making Music on Micros: A Musical Approach to Computer Programming for the Apple and the IBM PC. Computer Users Conference for Delaware Teachers K-12, Delaware State College, Dover, Delaware, June 19.

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Peripheral Development

During 1979, OCBI added to its staff the position of peripheral design engineer. This position was created in order to help the Office meet some hardware needs for research being done on the PLATO system and to facilitate the design of new equipment not currently available for the system. In 1982, a microcomputer development system was acquired to aid in hardware development activities. Some examples of how research problems have been solved and of how new equipment is being developed are provided for projects in psychology, physical education, music, art, and Latin.

Psychology needed a real-time clock accurate to 1/1000 second for measuring human response times to visual stimuli presented through microprocessor programs in the PLATO terminal. In order to meet this need, a timer was constructed. The design allows the researcher to make certain key connections which make the timer both versatile and easy to use.

Physical education needed a digitizer so that key points in films of human movements in competitive sports could be read by PLATO lessons in making accurate stick figures that could in turn be used to analyze and to correct errors in sports movements. This need was fulfilled by purchasing a Bit Pad from Summagraphics Incorporated and interfacing it to the PLATO terminal in the Biomechanics Laboratory.

A long-standing need of the music project had been a music synthesizer which could provide control over timbre, envelope, and special effects, in addition to time and frequency. A new music synthesizer, in production since the spring of 1981, was designed to contain fully programmable wave shapes and envelopes, plus control of glissando, tremolo, and vibrato. Based on a Z-80 microprocessor, the University of Delaware Sound Synthesizer (UDSS) can be used not only with the PLATO system but with any system that can send 8-bit parallel data. A Kay Elemetrics Pitch detector has also been interfaced to PLATO and the UDSS for the teaching of sight-singing. A polyphonic sound card for the IBM PC is under development, and connections of computer hardware to music devices through the MIDI protocol have been explored. In 1985, a scrolling device was constructed to aid in the production of the Videodisc Music Series.

In addition to designing new peripherals, OCBI is also making use of peripherals that have been developed elsewhere. Interfaces for the use of videodisc players with PLATO terminals and with microcomputers have been acquired. Two kinds of audio devices are being tested by the languages project. Support hardware for using ASCII terminals with the PLATO system has been purchased and integrated into the PLATO communications system. Finally, the department of art has taken advantage of a computerized loom set up with the assistance of OCBI's hardware staff.

This chapter contains a summary of activities in the departments using computer-based instruction at the University of Delaware. Sample lessons have been described with accompanying screen displays in order to give the reader a general idea of the kinds of applications being pursued in the Office. Study of these descriptions gives not only an overview of the wide range of activities that are being supported, but it also provides a source of ideas from which new applications can arise.

Accounting

In the past year, the Office of Computer-Based Instruction has provided 893 lesson hours to 296 accounting students, who are using drill-and-practice lessons to reinforce basic accounting concepts and prepare for written examinations.

Figure 10 shows a sample display from a lesson on cost accounting and the break-even point. This lesson provides a graph of the break-even equation and asks the student to choose a point on the graph; then the student is asked whether that point will result in a profit or a loss. As this process is repeated, students are guided to fill in a chart that shows how much profit or loss is obtained from various sales amounts.

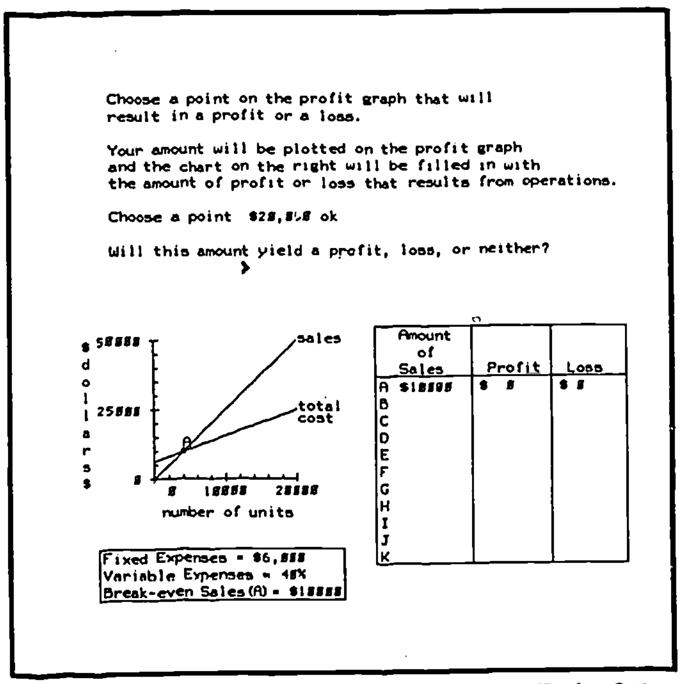

Figure 10. "What is Break-Even Point?," by Angelo Di Antonio and Louisa Bizoe. Copyright© 1979, 1980, 1981 by the University of Delaware.

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Figure 11 shows the computation of the cost to manufacture one unit of product. The student is asked to compute the dollar values of the ending inventory of finished goods using absorption costing. Direct costing is also explained in this lesson.

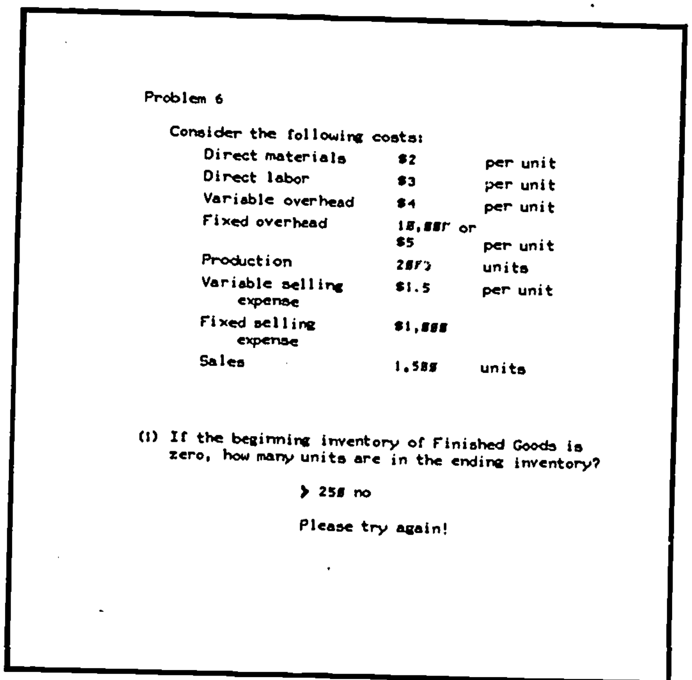


Figure 11. "Costing Methods," by Jeffrey Gillespie and William Childs. Copyright© 1979 by the University of Delaware.

Advisement Center

From 1982 to 1984, the College of Arts and Science Advisement Center designed and implemented a computer-assisted advisement program under a grant from the Fund for the Improvement of Post-Secondary Education. The principal investigator was Dr. Peter W. Rees, associate dean of the college.

The advisement program consists of a series of five PLATO lesson modules containing academic advisement information. The modules are intended for use by undergraduate students to enhance the quality of curriculum choice and are listed as follows:

1. Exploring Individualized Curriculum Options
2. General Academic Information
3. Student-Advisor Message System
4. Introductory Tutorial
5. Evaluation and Feedback

Module 1, "Exploring Individualized Curriculum Options," uses a data base developed by members of the advisement staff. It suggests majors, minors, and areas of specialization that are related to students' current majors, interests, or career objectives.

In figure 12, a communications major expressed interest in speech pathology, and the lesson listed academic subject areas related to this field. The student may choose to see detailed information on any of the majors, minors, and special programs offered in these areas.

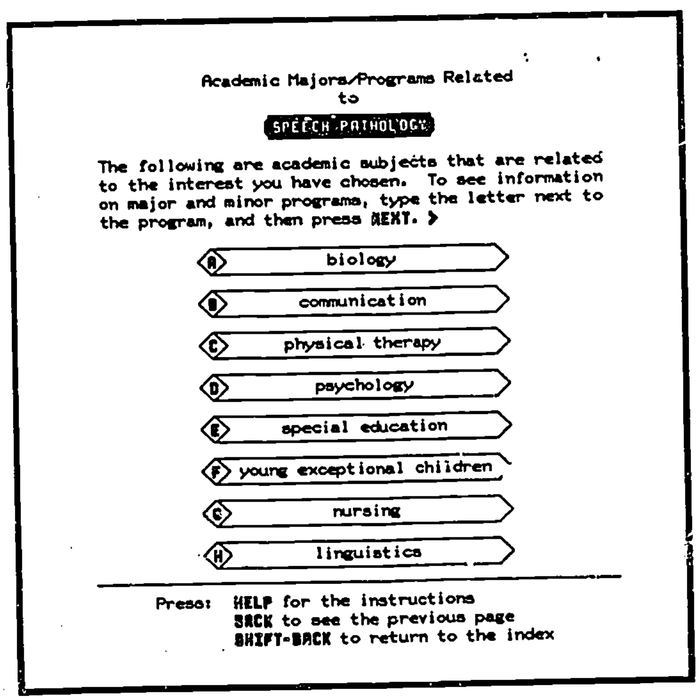


Figure 12. "Exploring Individualized Curriculum Options," by Peter W. Rees, Anita O. Crowley, and Sharon Correll. Copyright© 1984 by the University of Delaware.

The purpose of Module 2, "General Academic Information," is to provide students with quick access to information on any topic relating to the University's policies and requirements, from a description of the various types of degrees that are offered, to an explanation of drop/add policies, or a lesson on how to compute your G.P.A., as shown in figure 13. This module provides the information contained in the University's Academic Regulations and Policies Catalog, but in a more practical, easy-to-use format that allows students to see relationships between requirements and policies. This also frees advisors from answering routine policy questions and allows them to concentrate their efforts on more individualized advisement issues. Figure 14 shows the main index. In addition to accessing information through a series of index pages, students may also enter a keyword describing the type of information they would like to see, and the lesson will move directly to the display containing that information.

Module 3, the "Student-Advisor Message System," consists of a group of notesfiles in which a student may ask advisement-related questions and receive an individualized response from the advisement staff. This provides students with greater access to the Advisement Center, since they can use the PLATO Message System even when the advisors are not available for personal appointments. Students also benefit from being able to read other students' questions and advisors' responses to them, thereby gaining a broader awareness of University policies and academic opportunities. Also included in Module 3 is access to an on-line copy of each advisor's schedule.

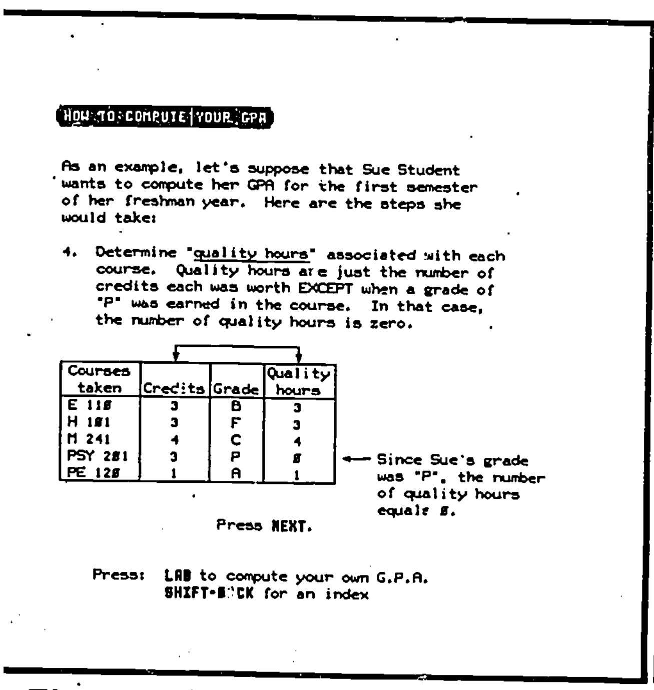


Figure 13. "General Academic Information," by Peter W. Rees, Sharon Correll, and the Staff of the College of Arts and Science Advisement Center. Copyright© 1982, 1983, 1984 by the University of Delaware.

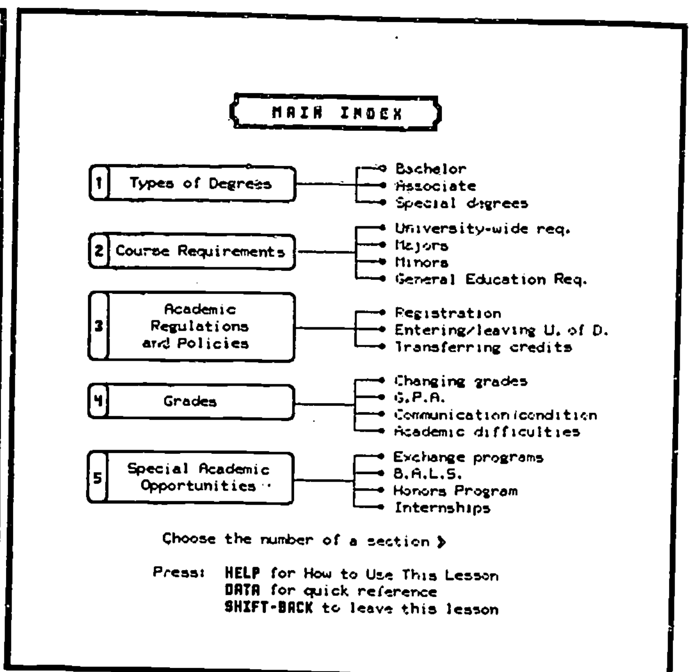


Figure 14. "Generai Academic Information," by Peter W. Rees, Sharon Correll, and the Staff of the College of Arts and Science Advisement Center. Copyright© 1982, 1983, 1984 by the University of Delaware.

In order to evaluate the effectiveness of the Advisement System, statistics are kept as to the amount and the type of use it receives. This is done by Module 5, "Evaluation and Feedback," which collects information on how many students use the system in any given period of days, how long each student spends using the system, where and at what time of the day it is used, and which lessons are accessed. This assists the advisement staff in determining the helpfulness of each module and the factors that contribute to student use.

An on-line questionnaire has also been developed to acquire information such as the classification, college, and major of each student who uses the Advisement System. With this data, advisors are not only able to determine who is using the system, but also what lessons each type of user finds helpful.

Agriculture

Faculty members from the Departments of Animal Science and Plant Science are using PLATO to provide students with simulated laboratory experiments and field experience that would be very costly to provide by other means. A number of the programs were originally developed by the College of Veterinary Medicine and by the Community College Biology Group at the University of Illinois. The successful implementation of these programs at the University of Delaware shows how through "courseware sharing" one institution can take advantage of PLATO programs written elsewhere.

In Animal Science, beginning students are using the PLATO system to study veterinary terminology, principles of digestion, muscular movement, mechanics of breathing, neuron structures and functions, spinal reflex loops, eye anatomy, and elementary psychophysiology of audition. Advanced undergraduates study mitotic cell division, probability and heredity, drosophilia genetics, natural selection, mitosis, gene mapping in diploid organisms, blood typing, population dynamics, pedigrees, karyotyping, and DNA, RNA, and protein synthesis. Graduate students concentrate on meiosis and the anatomy and physiology of reproduction.

In Plant Science, undergraduates can run PLATO programs in cellular structure and function, water relations, diffusion, osmosis, genetics, and the spectrophotometer. Graduate students study plant pathology, enzyme experiments, respiration, biogeochemical cycles, enzyme hormone interactions, photosynthesis, seed germination, apical dominance, flowering and photoperiod, fruiting and leaf senescence, gas chromatography, and gene mapping in diploid organisms.

One kind of experience that agriculture students obtain from using the PLATO terminal is illustrated in the following example. Figure 15 shows a sample display from the neuron structure and function program. This PLATO lesson simulates neurons with various internal structures. The student stimulates the neurons by

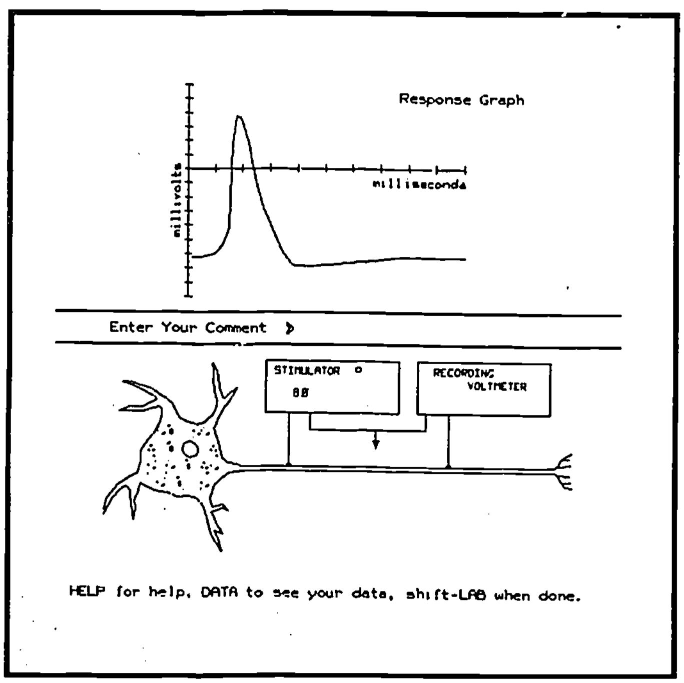


Figure 15. "Neuron Structure and Function," by S. H. Boggs. Copyright© 1976 by the Board of Trustees of the University of Illinois.

pressing keys at the terminal and observes the effects of the stimulations as read by a recording voltmeter. The student can experiment with different rates and patterns of stimulation. The PLATO system keeps track of what the student does and provides the student with reports in the form of response graphs.

The College of Agriculture's Department of Animal Science has developed a package of five PLATO lessons that deal with the endocrine system. These lessons cover the following topics:

1. Terminology and Definitions
2. Listing and Classification of Endocrine Structures
3. Location of Endocrine Structures in Mammalian Species
4. Location of Endocrine Structures in Avian Species
5. Hormones Secreted by Endocrine Structures

While the first two lessons teach terminology, definitions, and classifications of endocrine structures, the third lesson presents the students with an outline of the human body. Students are asked what endocrine structure they would like to see. Figure 16 shows how one student has asked to see the kidneys, and PLATO has responded by drawing kidneys in the proper locations. Later on in the lesson, the body outline is drawn again with all of the structures drawn in their proper locations, and the student is required to correctly identify each structure. Figure 17 shows how this way of teaching locations of endocrine structures was expanded to include avian species in the fourth lesson.

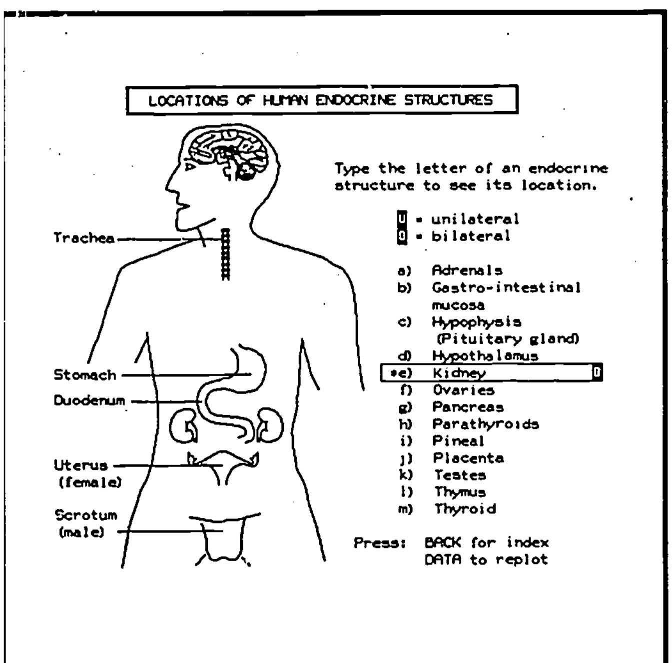


Figure 16. "An Introduction to the Endocrine System: Location of Endocrine Structures in a Mammalian Species," by Paul Sammelwitz, Daniel Tripp, and Michael Larkin. Copyright© 1986 by the University of Delaware.

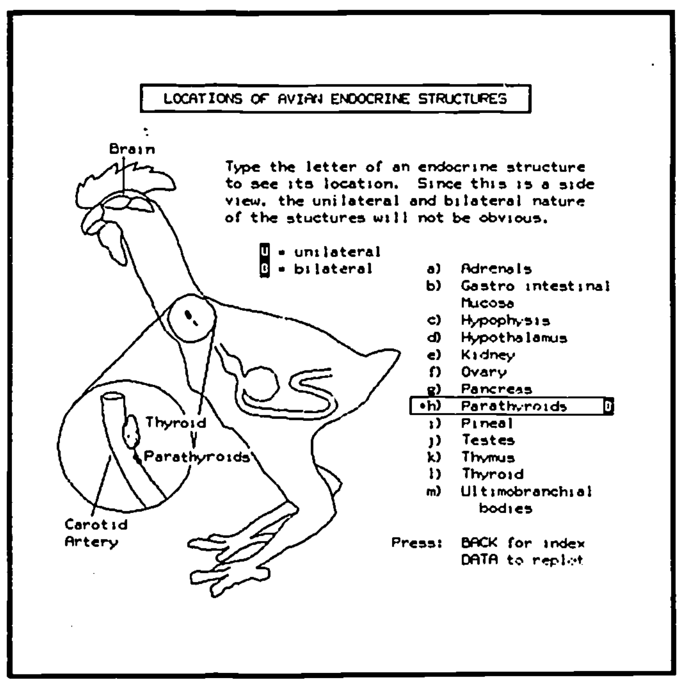


Figure 17. "An Introduction to the Endocrine System: Location of Endocrine Structures in Avian Species," by Paul Sammelwitz, Daniel Tripp, and Michael Larkin. Copyright© 1986 by the University of Delaware.

Another package developed by the Department of Animal Science deals with animal nutrition. Figure 18 shows how students are introduced to the concepts of "as fed" versus dry matter feedstuff nutrient content. Graphics and an animation help students visualize the relationship between these two concepts. Figure 19 shows how this package teaches students to prepare a balanced animal ration for monogastric animals. The students choose an animal to feed, and they select up to four feedstuffs to be used in the ration. The students can either perform step-by-step calculations on their own, or they can ask to be shown the balanced ration formulation. Students can repeat this process as often as they wish in order to create a balanced ration using the most desirable proportion of available feedstuffs.

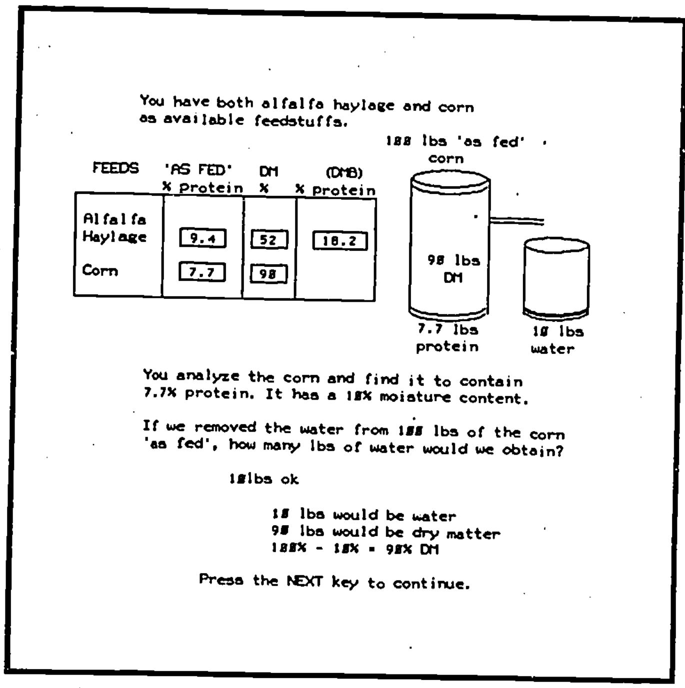


Figure 18. "Preparing a Balanced Animal Ration," by William Saylor and Gladys Sharnoff. Copyright© 1981 by the University of Delaware.

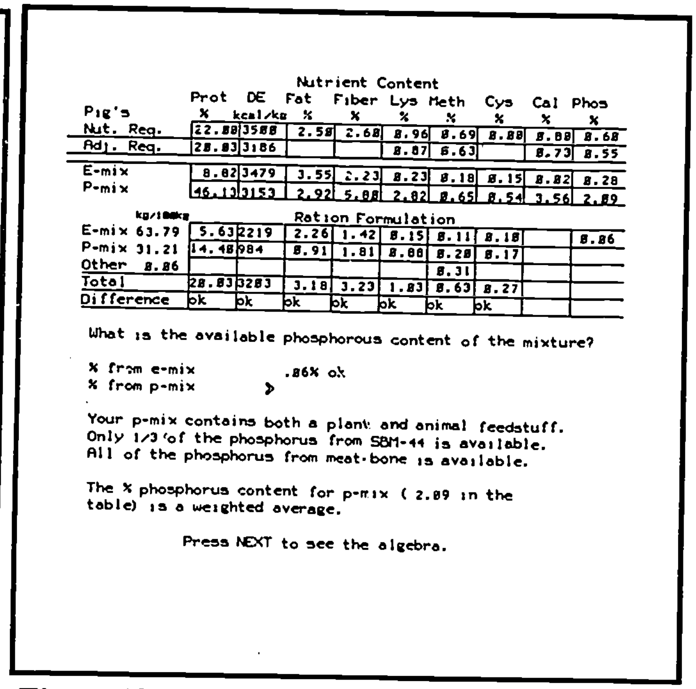


Figure 19. "Preparing a Balanced Animal Ration Laboratory," by William Saylor and Gladys Sharnoff. Copyright© 1981 by the University of Delaware.

In 1983, a three-lesson series on the senses was developed. The objectives of the first lesson, "Identifying the Senses," are to help the student become familiar with the anatomy and physiology of the senses and their receptors and to increase the awareness of the practical applications of that knowledge to the care and management of domestic animals. The student is asked to relate the senses to animal behavior and management practices. The second lesson offers a drill in relating the senses to their receptor organs and a tutorial in the classification systems used for the senses. In figure 20, the student has indicated the receptor organs for the sense of equilibrium and is being asked to locate them on a diagram of a domestic animal. The third lesson deals with the anatomy of the ear. In figure 21, the student has asked for information about an inner ear structure, the semicircular canals. The structure is highlighted, and its function is described.

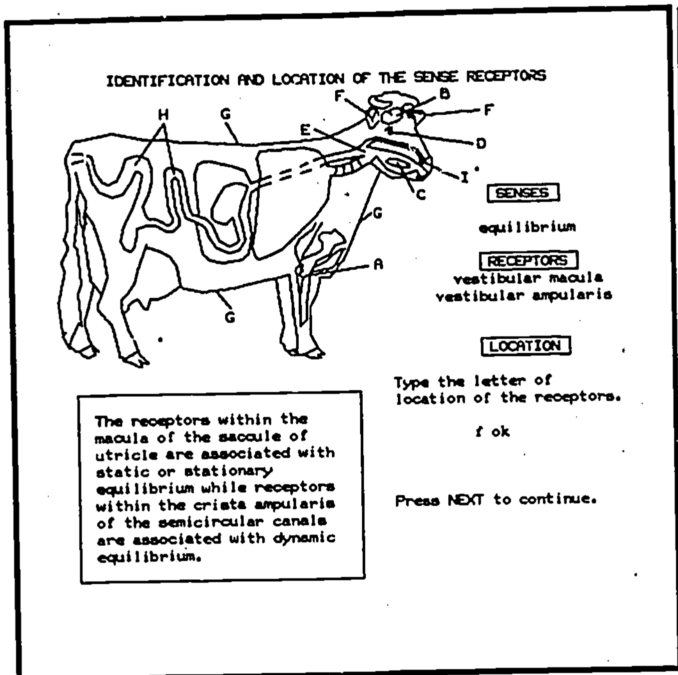


Figure 20. "Senses: Identification of Sense Receptors and Classification of the Senses," by Paul Sammelwitz, Gladys Sharnoff, and Clella Murray. Copyright© 1982, 1983 by the University of Delaware.

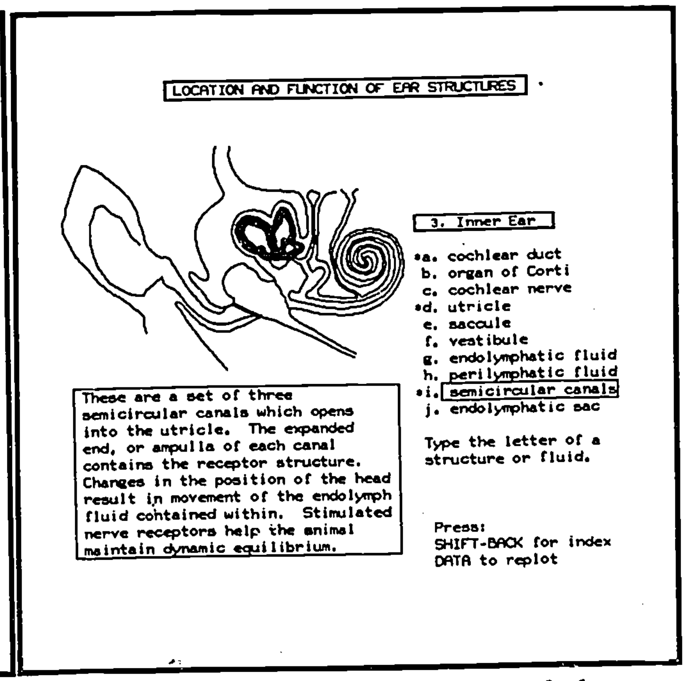


Figure 21. "Senses: Structures of the Ear," by Paul Sammelwitz, Gladys Sharnoff, and Michael Larkin. Copyright ©1982, 1983 by the University of Delaware.

The Department of Entomology and Applied Ecology has developed a lesson that deals with dance language in honey bees. Bee dance language is an example of the precision and diversity of animal communication. The lesson combines animation with high-resolution graphics to teach the information that is transmitted by bee dance behavior. Figure 22 shows one situation that a bee might encounter in its field foraging. The bee will translate this information into a wag-tail dance pattern in the hive. After presenting tutorials, simulations, and graphs of many bee dance behavior patterns, the lesson concludes by presenting a series of practice problems that test the student's knowledge of bee dance language.

Another lesson completed in 1984 is an insect order identification game called "What's My Kind?" Designed for use in introductory entomology courses, this game asks the student to identify an insect order described by a set of insect characteristics. Maximum points are earned if the order is identified with the least number of characteristics that can uniquely identify it. In figure 23, the student has just identified the order Hemiptera and has asked to see a diagram of an order member. An entomology hall of fame is included which lists the five highest game scorers. Students are expected to play the game several times to improve their scores and abilities to recognize the unique characteristics of each insect order.

Nearing publication is an entomology lesson entitled "All in the Family, an Insect Family Identification Game." This lesson uses the gaming strategy developed in "What's My Kind?" but deals with insect families rather than orders. It tests the student's knowledge of the families of nine insect orders. As in the first lesson, a hall of fame will list the names of the five highest scoring students.

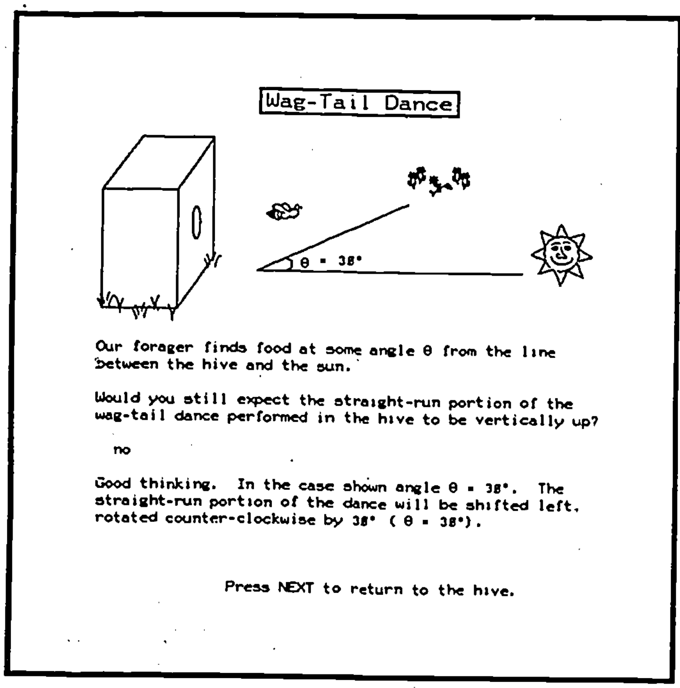


Figure 22. "Dance Language in Honey Bees," by Dewey Caron, Charles Mason, Gladys Sharnoff, and Miriam Greenberg. Copyright© 1985 by the University of Delaware.

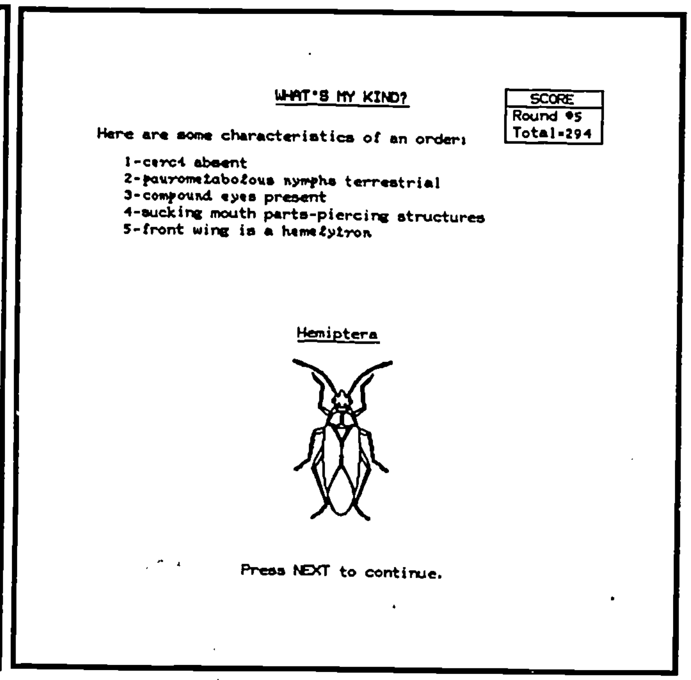


Figure 23. "What's My Kind? An Insect Order Identification Game," by Charles Mason, Gladys Sharnoff, Phyllis Andrews, Robert Charles, and Art Brymer. Copyright© 1984 by the University of Delaware.

The Department of Agricultural Economics has developed a program where students learn basic managerial skills through the use of an agribusiness simulation. This lesson contains actual data obtained from Southern States Cooperative, an agricultural business supply store. Students in agricultural marketing and management courses gain experience in solving typical problems faced by a manager in the areas of personnel, advertising, inventory, and merchandising. Figure 24 shows a typical display.

KEY INDICATORS

Key Areas	PERIOD 1		YEAR TO DATE	
	CUR YR	LAST YR	CUR YR	LAST YR
Margins & Service Income to Volume	15.3	18.5	15.3	18.5
Salaries & Wages to Volume	7.8	8.7	7.8	8.7
Expense to Volume	23.3	24.8	23.3	24.8
Net Savings to Volume	6.5*	6.6*	6.5*	6.6*
Volume Increase	22.3	6.3	22.3	6.3

* denotes red figure

Problem of the month:

Through your operational supervisor, the regional manager has informed you that maximum 8 percent merit raises are available for full-time personnel in your store. As manager you must determine the level of the pay raises for your employees. Several options are available to you. Justify your decision on the pay raise for each employee.

Pick a letter: >

OPTIONS

a. Resolve the problem
b. Review financial inventory management
c. Discuss problem with operational supervisor

Figure 24. "An Agribusiness Management Simulation," by Michael Hudson, Ulrich Toensmeyer, and Carol A. Leefeldt. Copyright© 1980, 1981 by the University of Delaware.

The College of Agriculture is also using PLATO Learning Management to make available practice tests for beginning animal science students. These tests present questions to students, record and grade responses, analyze errors, and suggest learning activities to improve scores on future practice tests, which students may repeat as often as they wish.

Anthropology

The Department of Anthropology has developed tutorials and drills for introductory courses in biological and socio-cultural anthropology.

An evolutionary perspective is important in the field of biological anthropology, which is the study of the biological aspects of man's culture. PLATO lessons that emphasize this perspective have been written about cellular structure and the genetic laws of inheritance.

Socio-cultural anthropologists are interested in the interrelationships among many aspects of the cultures they study. For instance, particular rules and obligations are associated with a group of people whose members live near one another or are related by blood. Examples of such rules include restrictions on permissible marriage partners and the manner in which two individuals address and communicate with each other. Socio-cultural anthropologists interested in studying the rules operating within a particular population group might include in an initial study the residence and descent patterns characteristic of the group.

Figure 25 shows a display from a lesson on anthropological residence theory in which a student has chosen a particular individual on a genealogical chart and then identified every member of the matrilocal residence group to which that individual belongs. Students learn that matrilocal residence groups exist in a population where unmarried children live with their parents, and married couples settle with or near the wife's parents.

In a lesson on anthropological descent theory, students must similarly identify descent relationships for a given individual in a population group. Later in the lesson, students are presented with an ethnographic description and are asked to identify the descent rule that applies to the population group described. As depicted in figure 26, a student has correctly identified the patrilineal descent rule that

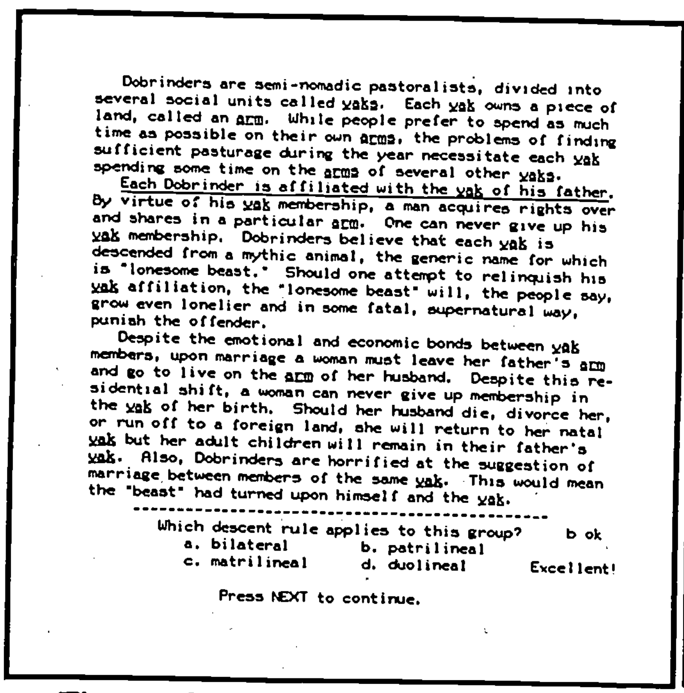


Figure 25. "Anthropological Resident Theory," by Norman Schwartz, Monica Fortner, Charles Collings, and Karen Sims. Copyright© 1985 by the University of Delaware.

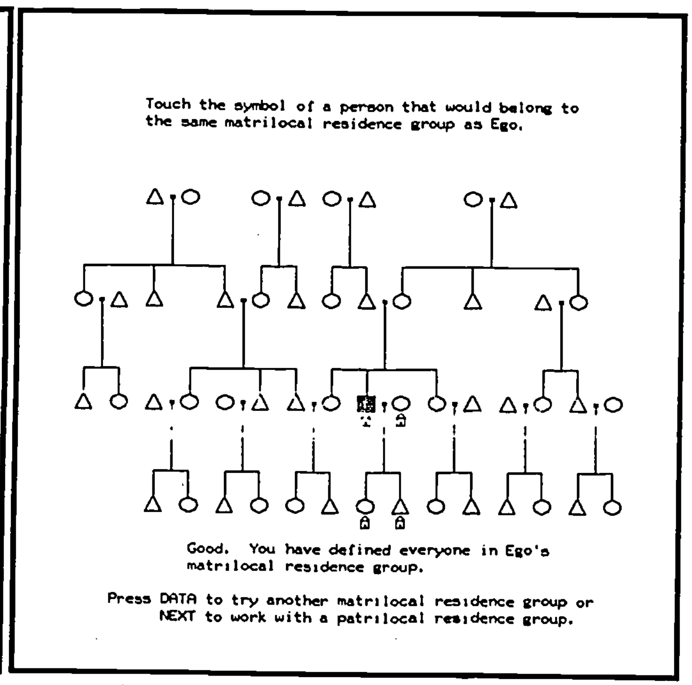


Figure 26. "Anthropological Descent Theory," by Norman Schwartz, Monica Fortner, Charles Collings, and Karen Sims. Copyright© 1985 by the University of Delaware.

rule that applies to a population group called the Dobrinders. The underlining in the text indicates to the student the portion of the description which should have made clear the descent rule that applies.

Professor Peter G. Roe was awarded a Local Course Improvement grant by the National Science Foundation to use the PLATO system in introductory and advanced anthropology courses to show how artistic style can be understood as a process, both as a formal system of visual logic and as a vehicle to convey symbolic information about the culture that produces it. Two lessons were developed and evaluated, one that introduces the concepts of aesthetic syntactics and gives examples of their application, and a second which requires students to utilize these concepts to create designs according to a specified set of rules. The first lesson illustrates the principle of Rule Replication Behavior on a graphic display. Figure 27 shows how students are asked to replicate a particular vessel by touching component parts reproduced on the screen, starting, as would a potter, with the base. In illustrating Rule Creation Behavior, students are asked to touch on a similar display any parts they wish to use in creating their own unique pots. Figure 28 shows an example of how the art style of the Cumencaya Indians can be analyzed using an art grammar. The rule of grammar appears in the box, and students can see how the rule is applied in the design that appears at the top of the screen.

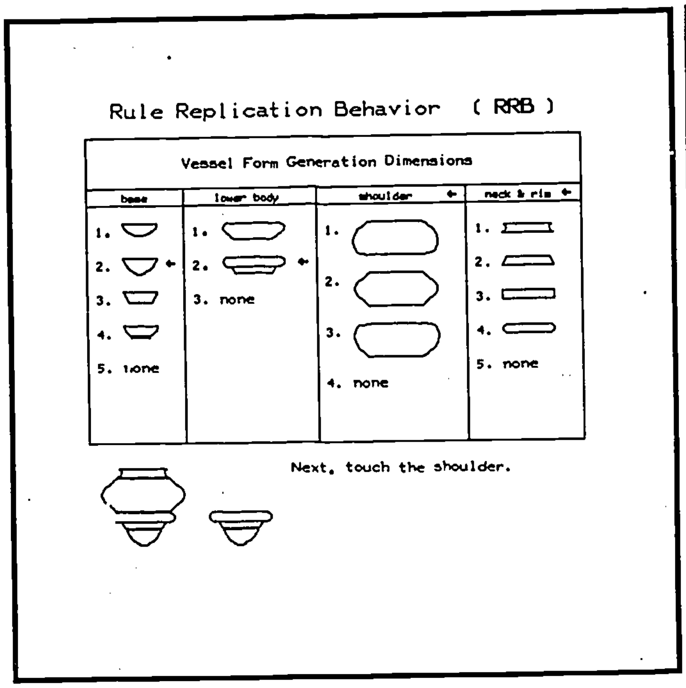


Figure 27. "The Anthropological Study of Art Style," by Peter G. Roe, Christine M. Brooks, and Karen Sims. Copyright©1980, 1981 by the University of Delaware.

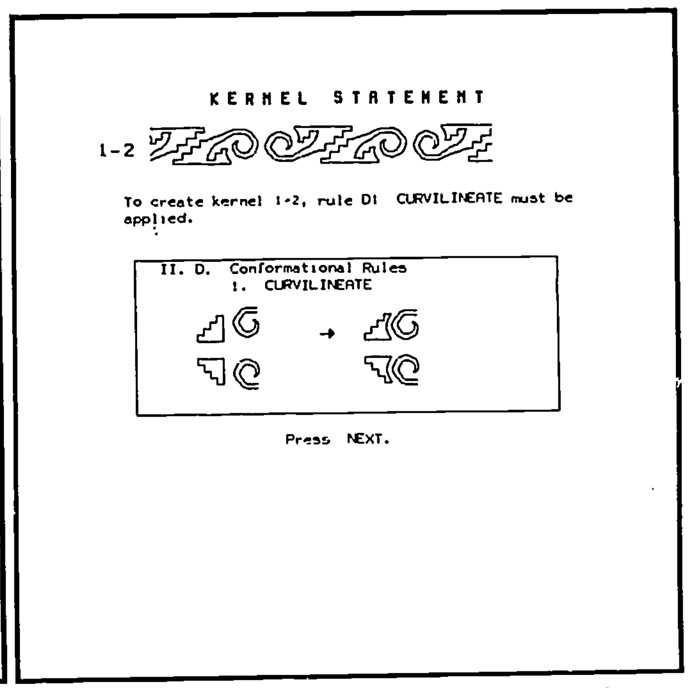


Figure 28. "The Anthropological Study of Art Style," by Peter G. Roe, Christine M. Brooks, Karen Sims, and Samuel Lamphier. Copyright© 1980, 1981, 1982 by the University of Delaware.

<u>Art</u>

In January of 1986, OCBI established a Macintosh site in the art department for use by Visual Communications students. Four illustrations demonstrate how a student can develop a two-page commercial layout on the Macintosh. Figure 29 shows an "S" copied from a newspaper by a ThunderScan™ image digitizer; the image has been enlarged 250% using MacPaint™. Figure 30 shows a second ThunderScan image that will form part of the layout. Figure 31 shows the composition process; the little hand on the screen is MacPaint's cursor, which allows the user to move the image on the page. Figure 32 shows the finished two-page layout.

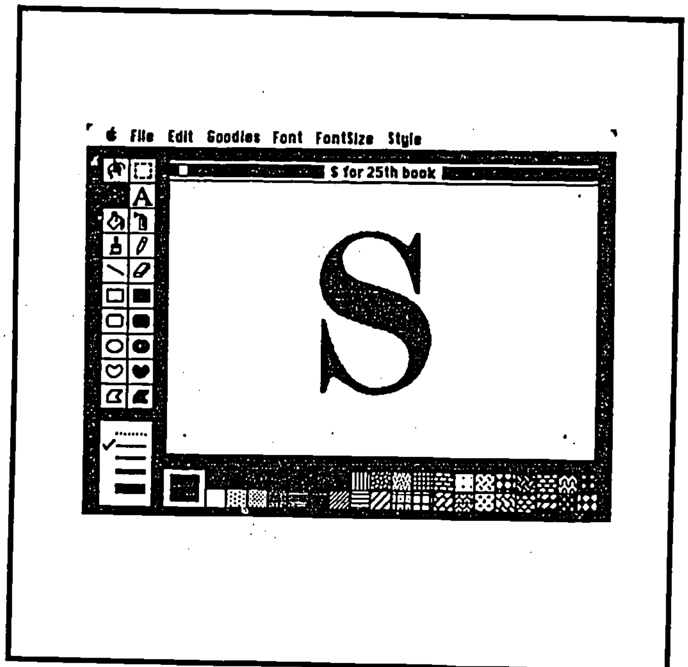


Figure 29. Drawing Done with ThunderScan and MacPaint. Copyright© 1984 by Apple Computer, Inc. Used by permission.

ThunderScan™ is a trademark of Thunderware, Inc.
MacPaint™ is a trademark of Apple Computer, Inc.

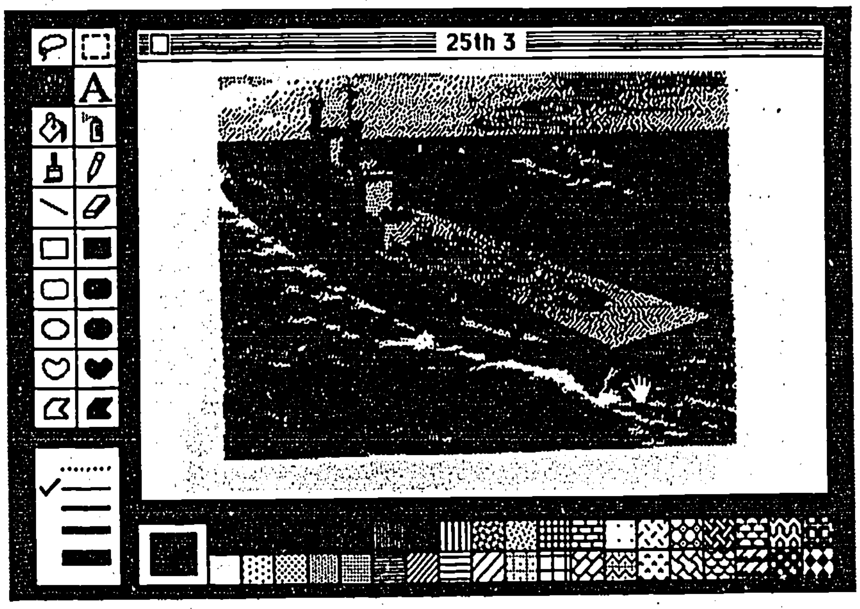


Figure 30. Drawing done with ThunderScan.

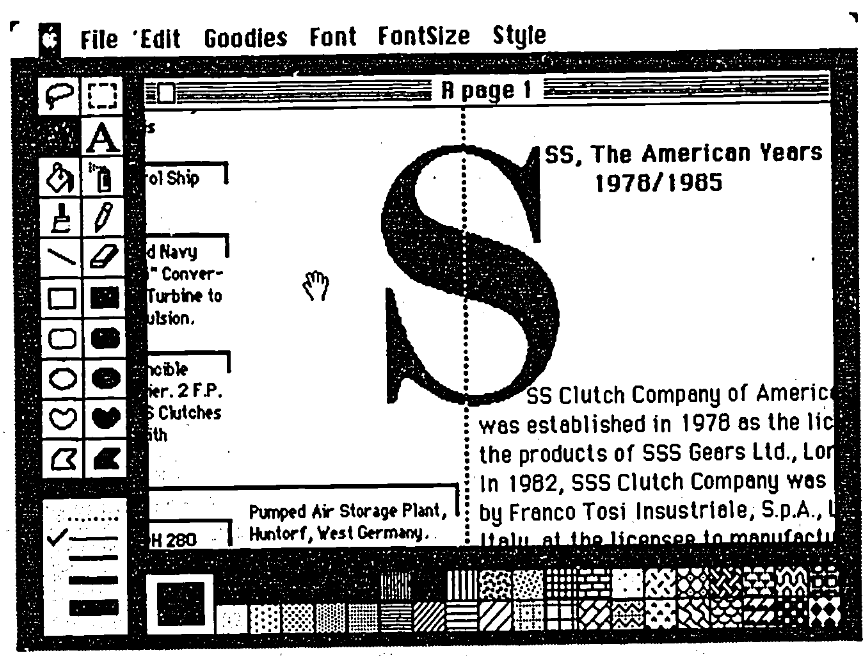
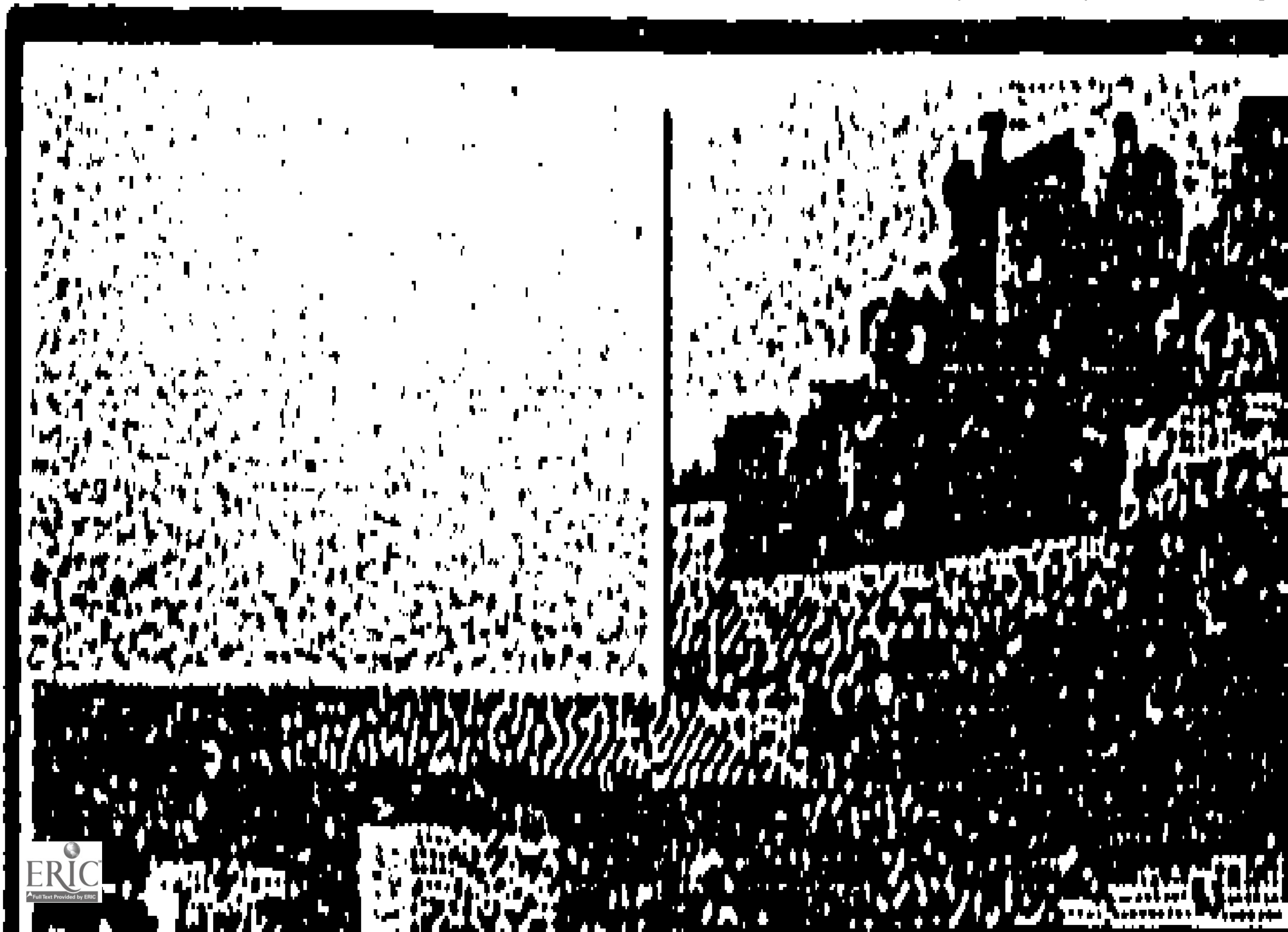


Figure 31. Drawing done with MacPaint.



Art Conservation

Because few microscopists skilled in project identification are available to art conservators, art historians, or curators, there is a need for conservation students and practicing conservators to be able to identify readily pigment samples taken from paintings and other works of art. Toward this end, a set of tutorials and drills called "Pigment Identification" has been developed for the Winterthur Art Conservation Program.

Pigment identification is an important aid to attribution, spotting of fakes and forgeries, and making decisions about conservation treatments. The pigment identification lesson familiarizes students with distinguishing characteristics of pigments, cogent dates, X-ray fluorescence spectra, and the advantages and disadvantages of various identification methods. An example of X-ray fluorescence spectra can be seen in figure 33. Figure 34 shows a reaction occurring during microchemical testing.

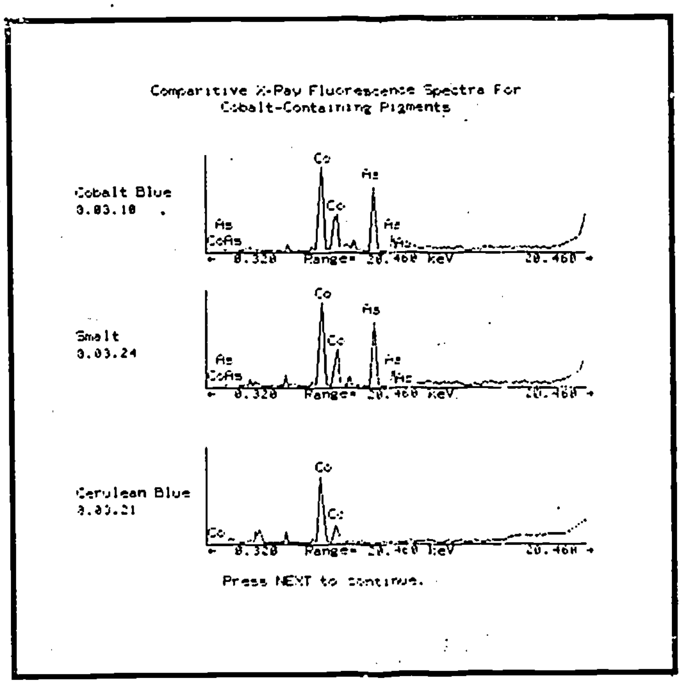


Figure 33. "Pigment Identification," by Joyce Hill Stoner, Brian Listman, Louisa Frank, and Chris Patchel. Copyright©1983, 1984 by the University of Delaware.

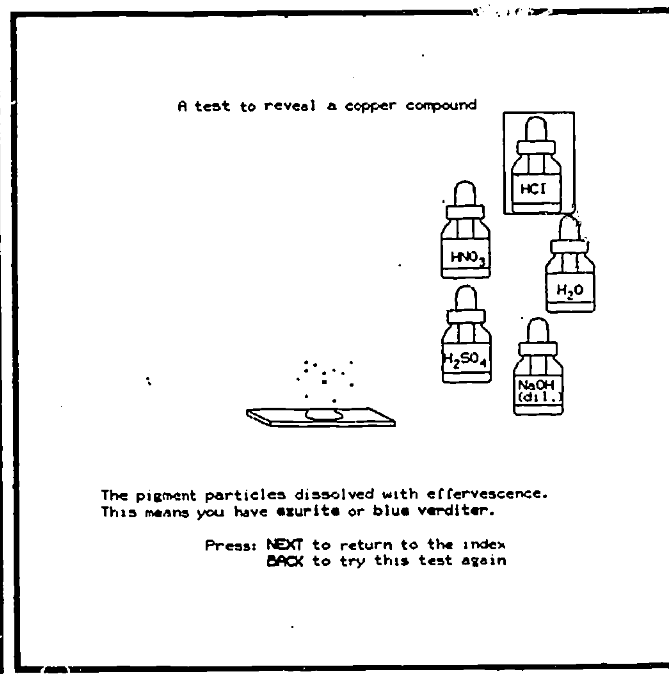


Figure 34. "Pigment Identification," by Joyce Hill Stoner, Brian Listman, Louisa Frank, and Chris Patchel. Copyright© 1983, 1984 by the University of Delaware.

Art History

The Department of Art History has developed a computer-based, interactive videodisc program called "Art History Resource Images as an Instructional Media" on an IBM Personal Computer configured to allow the overlay of videodisc images with computer-generated text and graphics. The program allows students to review 900 images used in the course Art of the Middle Ages in a self-paced, individualized format.

Students can review images classified by type or chronology. The computer program offers (1) quiz mode, in which the student must answer questions about the work's title, date of composition, artist, material of composition, and location; and (2) review mode, in which the students can choose the information to be displayed as shown in the photographs of the videodisc display in figures 35 and 36.

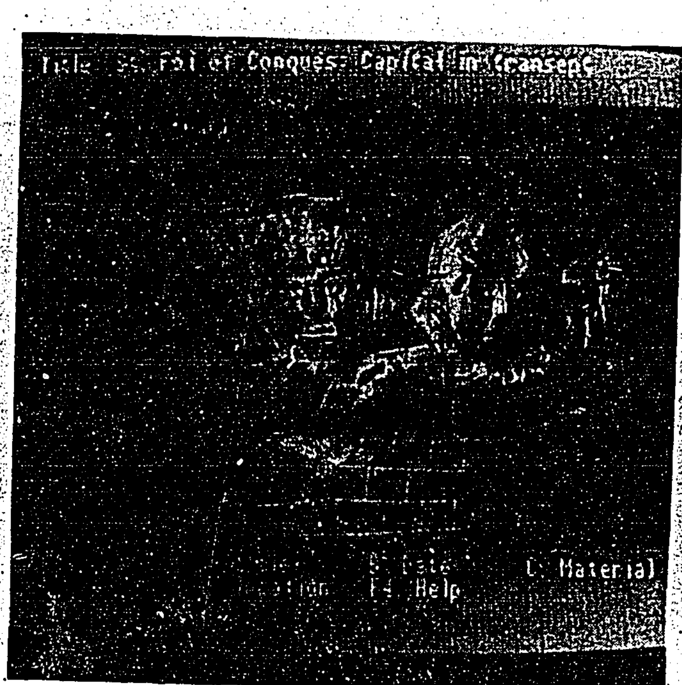


Figure 35. "Art History Resource Images as an Instructional Media," by Larry Nees, Ed Schwartz, Jim Hadlock, and Kaj Hansen. Copyright© 1986 by the University of Delaware.

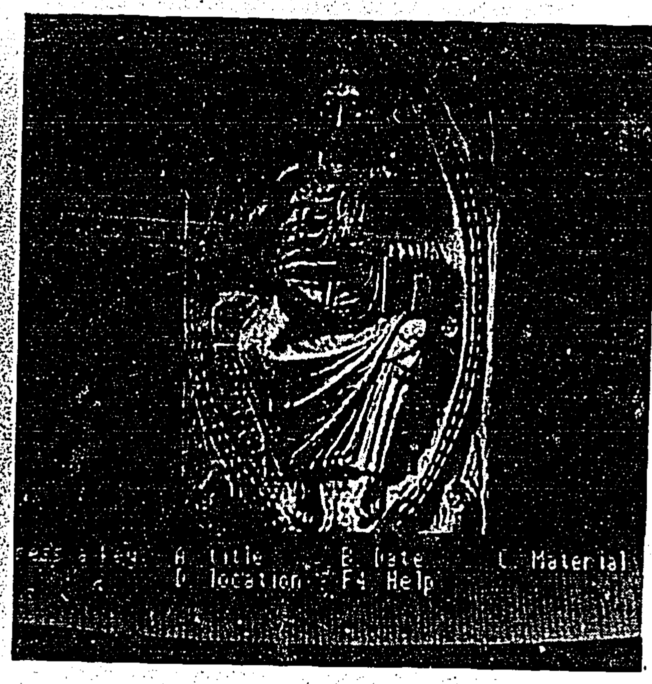


Figure 36. "Art History Resource Images as an Instructional Media," by Larry Nees, Ed Schwartz, Jim Hadlock, and Kaj Hansen. Copyright© 1986 by the University of Delaware.

Business Administration

During the fall of 1985, business finance students used a series of Illinois PLATO lessons which define basic financial terminology and present problems in areas such as compound interest, economic order quantity, and flexible budgeting.

Students are taken through sections on fundamentals of compound interest, methods of computing present and future values, and the present value of annuity tables. Figure 37 graphically shows the formula for the amount of an investment plus accumulated interest after five interest periods.

Students also learn why a "funds flow statement" is necessary, as well as how to construct and interpret one. Figure 38 illustrates three transactions that will affect the construction of a funds flow statement.

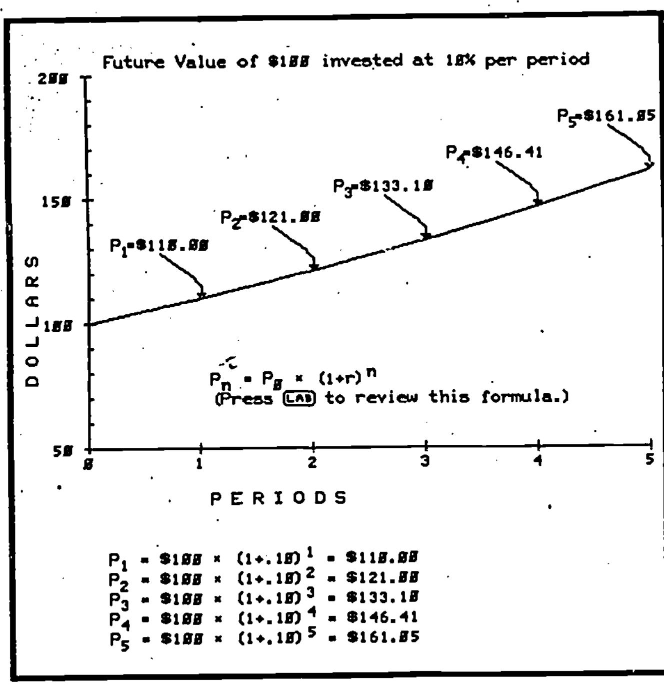


Figure 37. "Compound Interest," by James C. McKeown. Copyright© 1978 by the Board of Trustees of the University of Illinois.

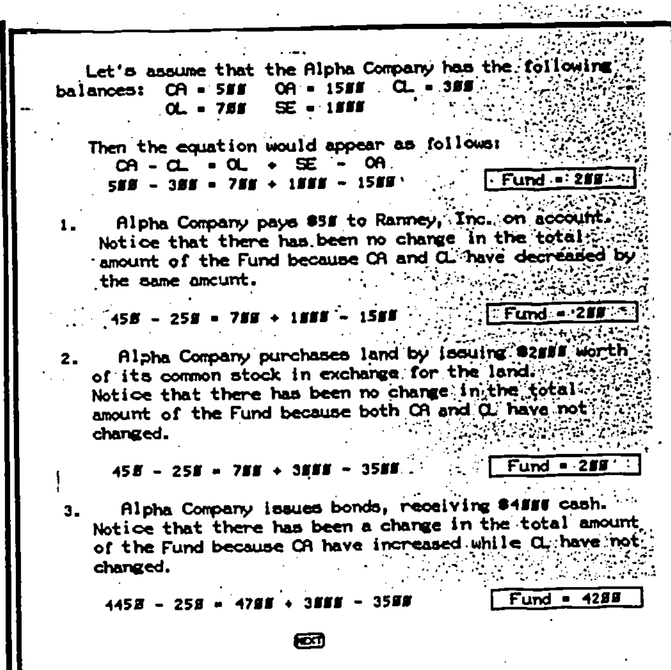


Figure 38. "Funds Flow," by James C. McKeown. Copyright©1978 by the Board of Trustees of the University of Illinois.

Chemical Engineering

An important aspect of engineering education is the development of problem-solving skills. Since large numbers of students are now choosing to major in chemical engineering, and since engineering students are avid computer users, the chemical engineering department has chosen to develop PLATO lessons to provide additional problem-solving experiences and tutoring for its students. This work has been partially supported by grants from the National Science Foundation and the Control Data Corporation.

Of the fifteen lessons that have been brought to the final stages of testing, review, and student use, thirteen are intended for the two-semester upper-level course sequence in chemical engineering thermodynamics. The other two were written for freshman and sophomore courses. Figure 39 is part of a lesson that (1) instructs the student on the use of an Othmer still to get vapor-liquid equilibrium data, and (2) tests the student's ability to analyze the data and extract activity coefficients to determine if the data are thermodynamically consistent and compare the activity coefficients with various theoretical models.

Figure 40 shows a sample display from a Rankine refrigeration cycle lesson, which instructs and tests undergraduate chemical engineering students on their understanding of thermodynamic cycles and the reading of thermodynamic diagrams. Following an idealized Rankine refrigeration cycle on a pressure-enthalpy diagram, students learn how to calculate the coefficient of performance.

Two of the PLATO lessons have recently been translated into Pascal to run on the IBM PC. There are plans to convert the other thirteen lessons as well. Except for the use of the touch panel, the IBM and PLATO versions are nearly identical.

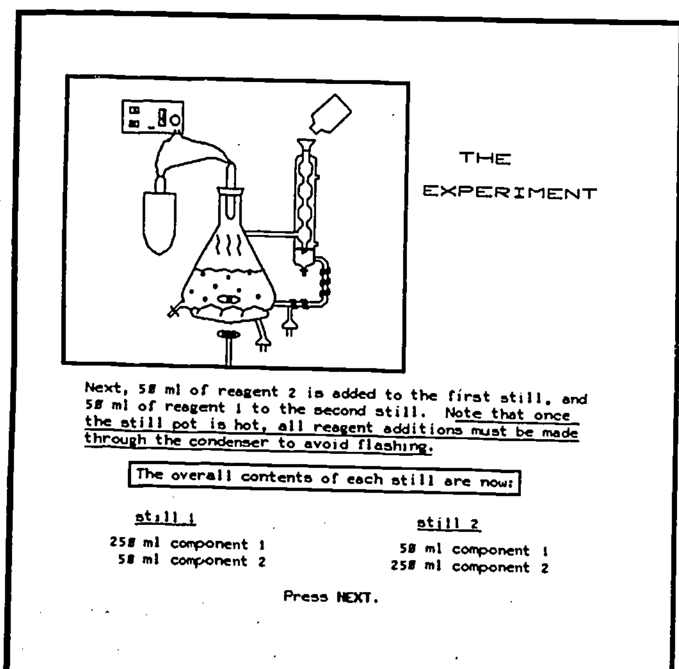


Figure 39. "Vapor Liquid Equilibrium in Binary Mixtures," by Stanley Sandler, Douglas Harrell, and Andrew Paul Semprebon. Copyright© 1984 by the University of Delaware.

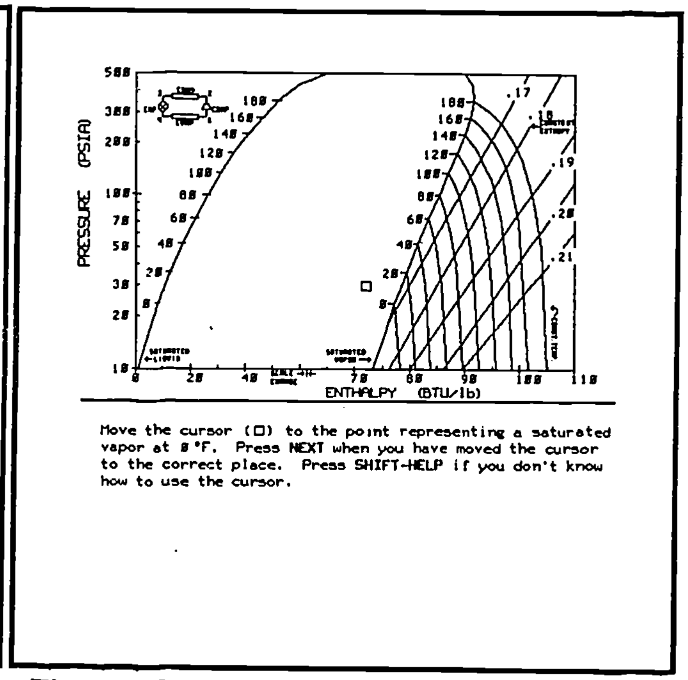


Figure 40. "The Rankine Refrigeration Cycle," by Stanley Sandler, Robert Lamb, and Andrew Paul Semprebon. Copyright© 1984 by the University of Delaware.

To deliver the IBM lesson materials, a network of twelve IBM PCs has been installed in Colburn Laboratory. Ten PCs are located in a student use area, and two are in faculty offices. The IBM PCs are connected by a 3COM Ethernet that provides a file server and a 35-megabyte hard disk. Printers are also connected to the network.

Network software includes WordPerfect®, dBASE II®, Microsoft FORTRAN®, Microsoft Pascal®, Lotus 1-2-3®, MMSFORTH®, IBM BASIC®, Microsoft Project Manager®, IMSL's Math/PC and Stat/PC Libraries, LINDO, Brit™, TK!Solver®, and PC-Write. Classes are being taught at faculty requests to introduce students to network software, word processors, and course specific software.

WordPerfect® is a registered trademark of Satellite Software International.
dBASE II® is a registered trademark of Ashton-Tate.
Microsoft FORTRAN®, Microsoft Pascal®, and Microsoft Project Manager® are registered trademarks of Microsoft Corporation.
Lotus 1-2-3® is a registered trademark of Lotus Development Corporation.
MMSFORTH® is a registered trademark of Miller Microcomputer Services.
IBM BASIC® is a registered trademark of International Business Machines Incorporated.
Brit™ is the trademark of Scientific Communications Corporation.
TK!Solver® is a registered trademark of Software Arts, Inc.

Chemistry

The Drake Hall PLATO classroom was established in the Department of Chemistry in the fall of 1979. Use of the PLATO system by chemistry students has been heavy ever since, and the number of workstations has increased to twenty-two PLATO terminals and four Micro-PLATO stations.

Taking advantage of the large package of chemistry lessons written under NSF funding at the University of Illinois, the Department of Chemistry has enjoyed much success helping students learn and reinforce basic knowledge of the principles of chemistry. Students can see simulations of chemical reactions in three dimensions. Drill-and-practice lessons offer students the opportunity to review sections and problems as much as is needed for firm comprehension. Diagnostic lessons help check achievement levels and progress. By using the computer to simulate chemical reactions, students get to work with many more samples than is possible in the traditional chemistry lab. In problem-solving, students have the freedom to experiment with many methods of finding a solution.

Figure 41 shows how students are checked on their knowledge of the energy levels of electron shells in a lesson on the Aufbau Principle. Each orbital is represented by a circle in order of increasing energy, and when each one is touched, a symbol representing an electron with spin direction is placed in it. The student must place the correct number of electrons in each orbital before getting credit for that element. After eight elements have been correctly displayed, the student proceeds to the next part of the lesson.

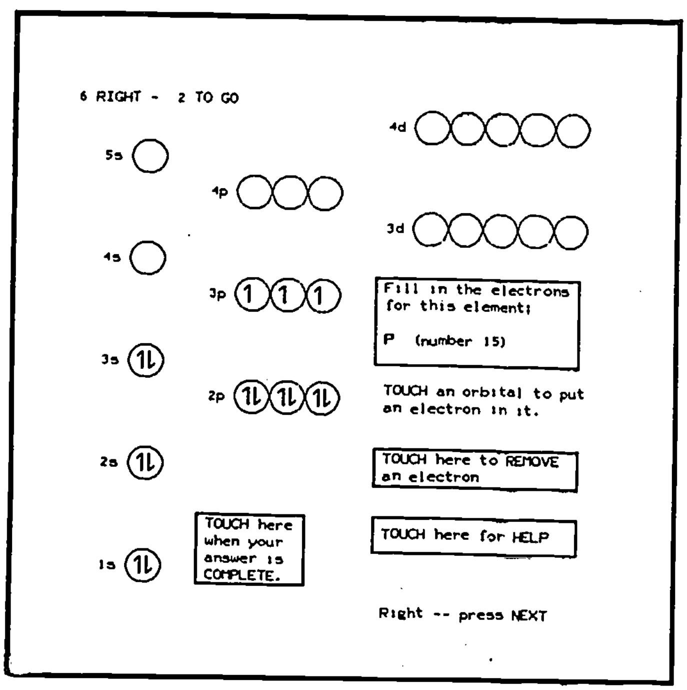


Figure 41. "Electronic Structure of Atoms," by Ruth Chabay. Copyright© 1976 by the Board of Trustees of the University of Illinois.

Figure 42 shows how the PLATO system teaches the standardization of an aqueous NaOH solution by simulating acid-base titrations. The student must perform every step in the simulation, from filling the buret to observing the change of color at the end of the experiment. The lesson makes sure the student follows correct laboratory procedures, helping out with suggestions when necessary.

Lessons have been developed at the University of Delaware to fill some gaps in the Illinois curriculum. Figure 43 shows a chart students build while learning the meaning of the pH factor and how logarithms are used in determining pH.

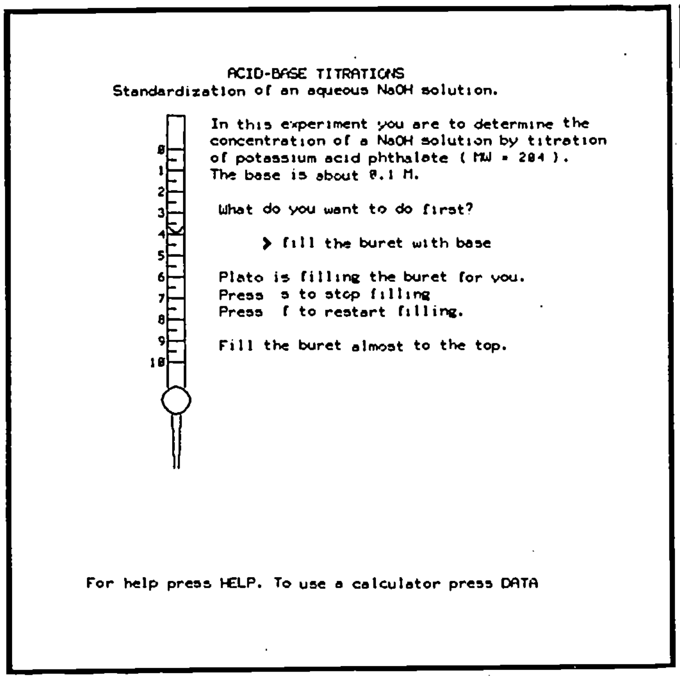


Figure 42. "Acid-Base Titrations," by Stanley Smith. Copyright© 1976 by the Board of Trustees of the University of Illinois.

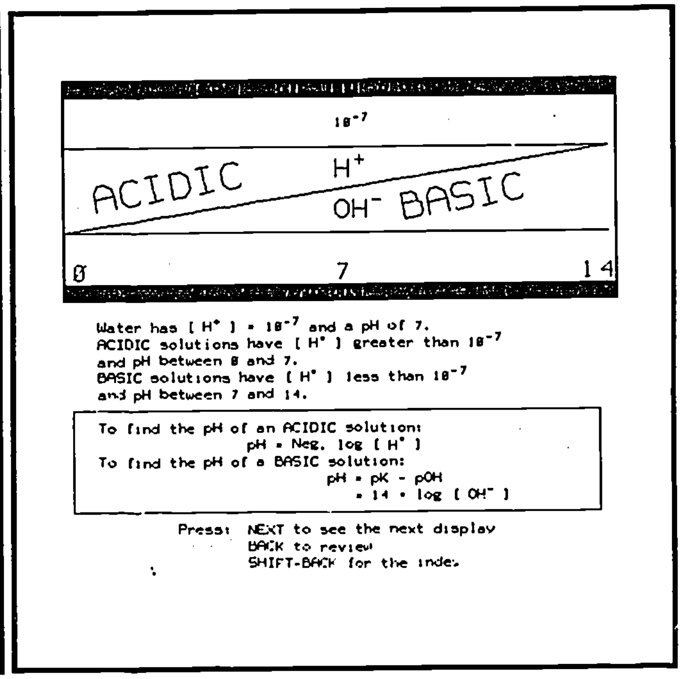


Figure 43. "Application of Logs: pH," by Bernard Russiello. Copyright© 1980, 1981, 1982 by the University of Delaware.

Figure 44 shows how high-resolution graphics help convey the concept of the spatial arrangement of molecules. The molecule in the picture is composed of a central atom, A, and six surrounding atoms, X. The picture shows how the surrounding atoms arrange themselves as far apart as possible on the surface of an imaginary sphere with the central atom as the center. In figure 45, the sphere is removed, and the octahedral framework of the molecule is drawn in dotted lines.

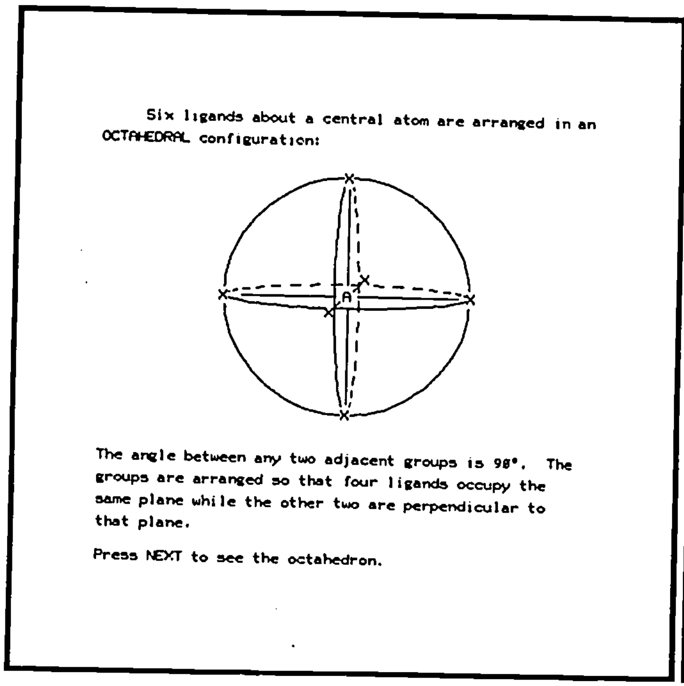


Figure 44. "Determining Shapes of Molecules: VSEPR," by Edward R. Davis, Roland Garton, Leonid Vishnevetsky, and Seth Digel. Copyright© 1980, 1981, 1982, 1983, 1984 by the University of Delaware.

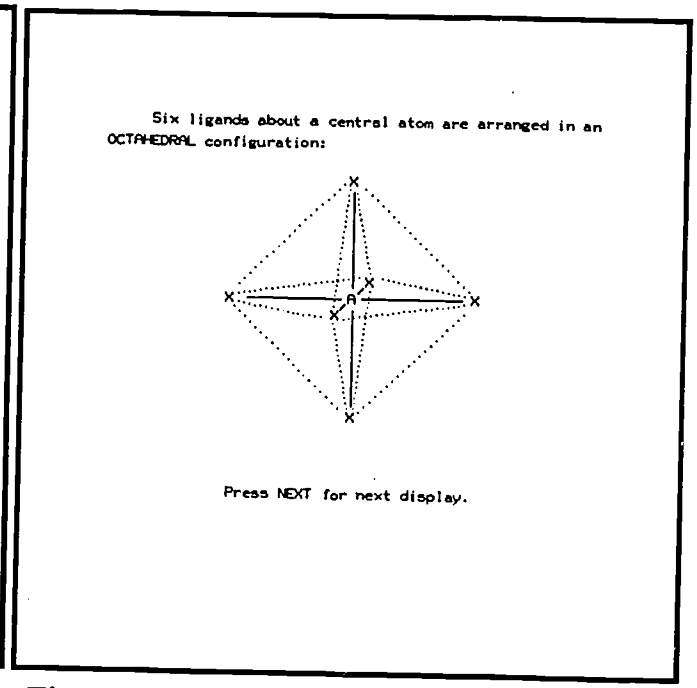


Figure 45. "Determining Shapes of Molecules: VSEPR," by Edward R. Davis, Roland Garton, Leonid Vishnevetsky, and Seth Digel. Copyright© 1980, 1981, 1982, 1983, 1984 by the University of Delaware.

In addition to PLATO lessons, students in Physical Chemistry use IBM PC software designed and programmed by their professor, Dr. Joseph Noggle. By working with his code, students learn BASIC and write programs designed to solve problems such as graphing chemical equations, calculating multiple regressions, performing integration, and evaluating polynomials, as shown in figure 46.

Figure 47 shows how students used one of Professor Noggle's graphing programs in the course Chemistry Problem Solving Using Computers, which teaches computer literacy for chemists and focuses on advanced BASIC programming.

```
ORDER OF POLYNOMIAL=5
ENTER COEFFICIENTS A(I)
A(0)=?34
A(1)=?21
A(2)=?67
A(3)=?31
A(4)=?71
A(5)=?20
INITIAL GUESS FOR R23
18.2683373        14.4851688
11.4611184        9.0446602
7.11449497        5.57342016
4.34337751        3.36141611
2.57633216        1.94572378
1.43305559        1.00380084
.617571113        .200879379
-.561937675       .10845939
-.894560179       -.401947117
.667727597        .262481642
-.398178471       .688482859
.287074726        -.340920548
1.10026404
```

Figure 46. "Chemical Kinetics," by Joseph Noggle. Copyright© 1985 by Joseph Noggle. Used by permission.

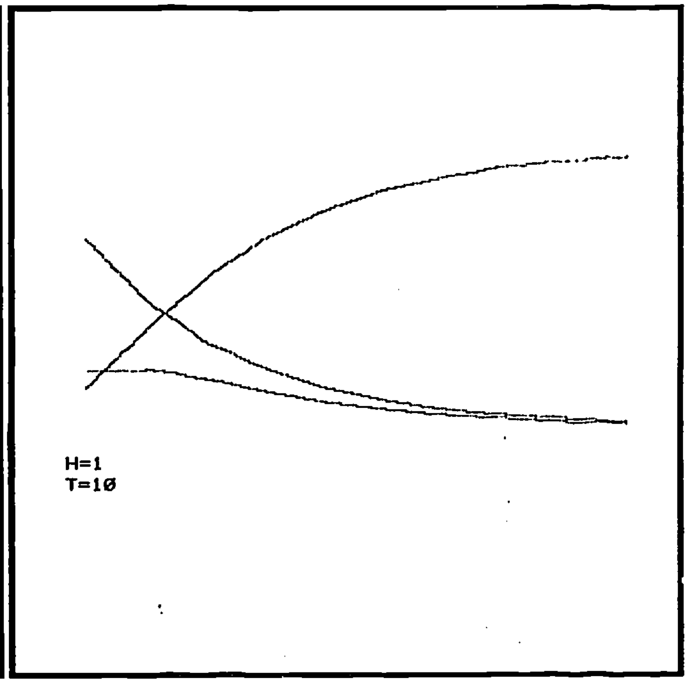


Figure 47. "Chemical Kinetics," by Joseph Noggle. Copyright© 1985 by Joseph Noggle. Used by permission.

Civil Engineering

A course in Structural Dynamic Design is using OCBI's networked classrooms of IBM PCs to deliver a Fourier transform program that allows the user to choose parameters from which it produces a data file on disk. Students have learned to use Lotus 1-2-3 to overlay graphs from several passes of the program so the results can be compared. Figures 48 and 49 show a simple example of student input to the Fourier transform program and the resulting Lotus® graph.

```
N: power of 2, gives total time intervals
T: period of input function

value of N ? 4
value of T ? 2

k        Xr          Fw
=        ==          ==

0     1.000000    1.000000
1     0.628418    0.636620
2     0.000000   -0.000000
3    -0.187076   -0.212207
4     0.000000    0.000000
5     0.083522    0.127324
6     0.000000   -0.000000
7    -0.024864   -0.090946

Do you want to save the data into a file ? y

Your data will be stored on drive A. Make sure your disk is there
Save each set of results under a different file name
Data file name (filename.prn): fft.prn
Do you want to print your data? y
```

Figure 48. Student Input to the Fourier Transform Program and Sample Output from the Program.

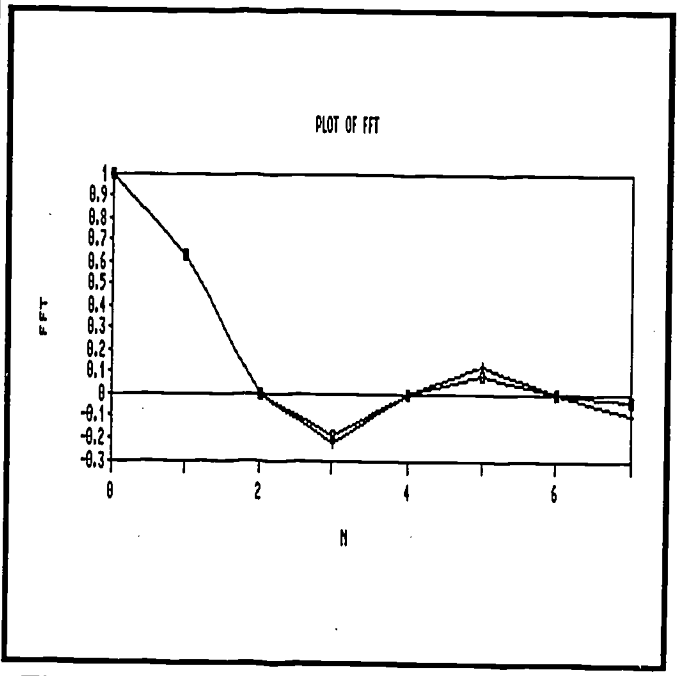


Figure 49. Graphic Display of Output Data from the Fourier Transform Program.

Communications

Students in the course Introduction to Communications have used the Introduction to Statistics course on the OCBI VAX in both fall and spring semesters. Students must complete two modules of the statistics material covered in class. The modules provide tutorial explanation of the materials followed by interactive exercises. Users have access to an on-line glossary of terms and interactive statistical tables. For a complete description of this package, see "Statistics."

Lotus® is a registered trademark of Lotus Development Corporation.

Computer and Information Sciences

In the summer of 1985, students from the Introduction to Computer Science course learned Pascal programming on the Apple II+. Along with Delaware public school teachers participating in an accreditation program to teach computer science at the secondary school level, students wrote original computer science and utility programs. The Pascal features that were stressed included file manipulation, arrays, sorting, and modular and structured programming. The students wrote utilities that included a loan repayment schedule, a bank account manager, and a grade distribution analyzer. The bank account manager illustrated in figure 50 maintains savings account records and generates a printout of transactions and initial and ending balance information. The grade distribution program shown in figure 51 determines the mean and standard deviation for a set of class grades and prints a histogram.

```
INITAL BALANCE = $      400.67
ACCOUNT NUMBER          500
NAME : JOE JONES
WITHDRAWAL OR DEPOSIT :  W      AMOUNT:          45.67
WITHDRAWAL OR DEPOSIT :  D      AMOUNT:         100.00
ENDING BALANCE IS $       455.00
INITAL BALANCE = $      890.78
ACCOUNT NUMBER          501
NAME : HARRY APE
WITHDRAWAL OR DEPOSIT :  W      AMOUNT:          10.00
WITHDRAWAL OR DEPOSIT :  D      AMOUNT:          30.00
ENDING BALANCE IS $       910.78
```

Figure 50. Student-Written Utility, "Savings Account Balance Report."

```
COMMAND: E(DIT, R(UN, F(ILE, C(OMP, L(IN
90
96
91
87
56
78
78
30
100
 35.12
          TEST GRADE DISTRIBUTION
 0  -   9
10  -  19  ******
20  -  29  ***
30  -  39  *********
40  -  49  ***
50  -  59  ************
60  -  69  ***
70  -  79  ******************
80  -  89  ***************
90  - 100  ****************************
                5        10        15

F
```

Figure 51. Student-Written Utility, "Histogram of Test Grade Distribution."

Continuing Education

The Division of Continuing Education has continued its ongoing program of career counseling using lessons developed jointly with the Counseling Center. Students obtain career information and guidance from a PLATO terminal located in Clayton Hall. The counseling programs include an on-line version of John Holland's "Self-Directed Search," an occupational information-by-title lesson that allows students to explore career information on 510 different occupations, and the "Exploring Careers" series that was developed by Dr. Richard Sharf with funding from the Center for Counseling, the Division of Continuing Education, and the Control Data Corporation. These programs are explained in depth in the counseling section of this report.

The Division also continues to offer three popular non-credit microcomputer seminars for professional and personal development. These seminars provide training to the general public on using and evaluating microcomputers. "Introduction to Personal Computers" was offered seven times with a total enrollment of 210 students. Topics included a discussion of terminology, architecture, and features of microcomputers; issues to consider when purchasing hardware and software; a comparison of programming languages; demonstrations of software packages; and demonstrations of microcomputers and peripherals. "Introduction to BASIC Language Programming" was offered twice with a total enrollment of 15 students. Topics included a discussion of variables, manipulating the flow of execution, evaluating input, arrays, and string processing. "Introduction to WordStar®" was offered twice with a total enrollment of 15 students. Topics included inserting, changing, deleting, moving, saving, printing, centering, and finding text. Each seminar consists of four three-hour sessions; part of each session includes laboratory work in an OCBI microcomputer classroom.

WordStar® is a registered trademark of MicroPro International Corporation.

<u>Counseling and Career Planning and Placement</u>

In July of 1980, Senior Psychologist Richard Sharf received a grant of $50,000 from the Control Data Corporation to complete the Exploring Careers Series and modify it for the urban/underprivileged population that CDC addresses through its Fair Break program. A second grant of $175,000 was awarded in January of 1981 to continue work on the Exploring Careers Series as well as several other lessons on career development and education. These grants culminated in 1982 with the conversion of many lessons to run on the Micro-PLATO stations in a low-cost format.

The Exploring Careers Series is similar to its predecessor, the Career Search, which Dr. John Holland developed in 1970. One of the major differences is that the Exploring Careers Series is designed not only to help students explore occupational alternatives, but also to narrow down their choices. Students are guided through this process, which may take two to three hours, by the two cartoon characters shown in figure 52.

The Exploring Careers Series has three main parts. Part 1 introduces students to a wide range of careers by asking them to indicate their interest in each of sixty-two careers. Unlike other career interest inventories that rely on career stereotypes, this one allows students to look at information about each occupation before making their ratings. Figure 53 shows one of the four pages of ratings that students are asked to complete. Using John Holland's typology, students are given scores in six areas: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. On the basis of these scores, students are presented with an ordered list of occupations from which to choose in Part 2.

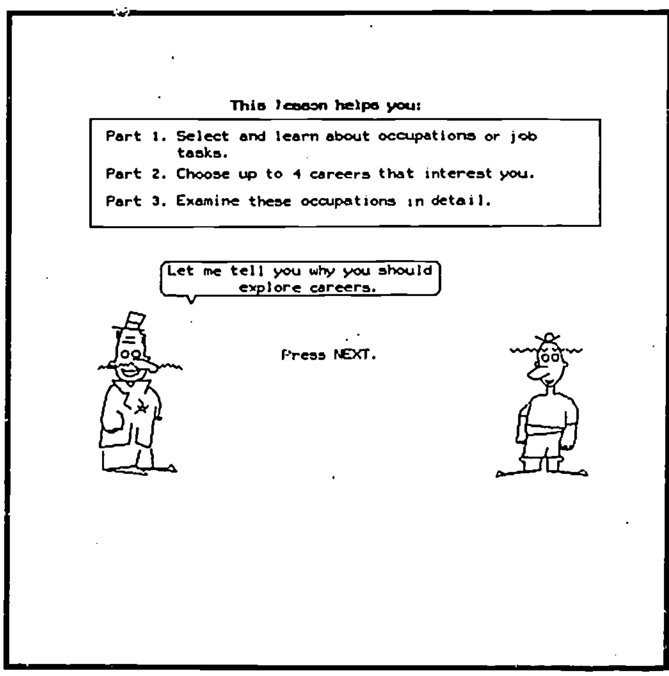


Figure 52. "Exploring Careers: Introduction," by Richard Sharf. Copyright© 1979, 1980, 1981 by the University of Delaware.

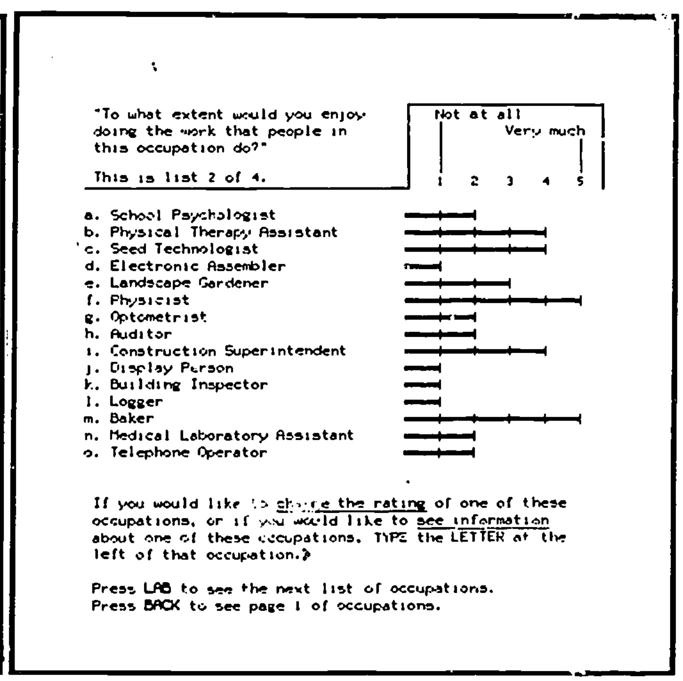


Figure 53. "Exploring Careers: Part 1," by Richard Sharf. Copyright© 1980, 1981 by the University of Delaware.

If the students have already chosen an occupation, they can go directly to Part 2 without completing the ratings. Part 2 contains 510 jobs from which students can choose 2, 3, or 4 that they wish to save and examine further. Figure 54 shows the options available to students interested in learning more about listed occupations. When students have decided which occupations to investigate further, they proceed to Part 3.

Part 3 of the Exploring Careers Series was designed to help high school students and dropouts be realistic about career choices. Students are asked to rate each occupation they saved on six characteristics: interest in the occupation; attainability of education level; ability to meet qualifications; acceptability of salary; acceptability of working conditions; and the riskiness of the job market. Figure 55 gives an example of the occupational information and the rating instructions.

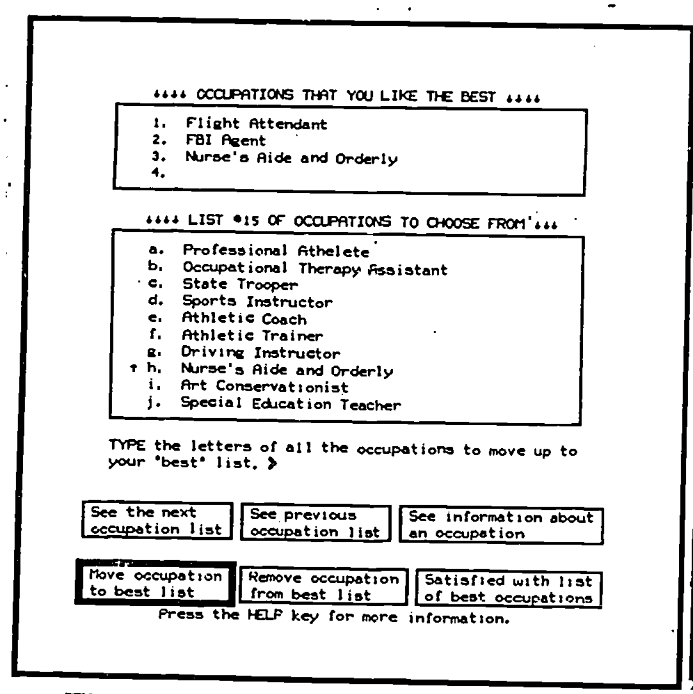


Figure 54. "Exploring Careers: Part 2," by Richard Sharf. Copyright© 1979, 1980, 1981 by the University of Delaware.

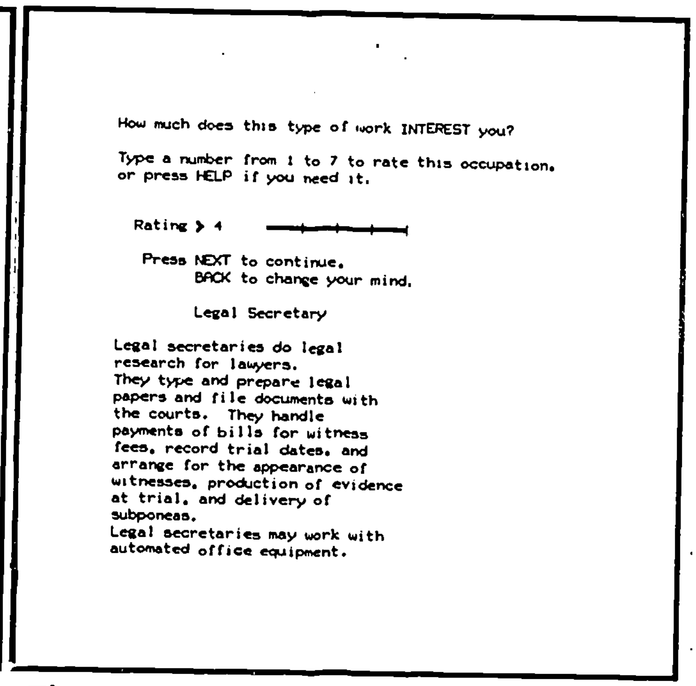


Figure 55. "Exploring Careers: Part 3," by Richard Sharf. Copyright© 1979, 1980, 1981 by the University of Delaware.

The occupation data base of the Exploring Careers Series contains summary information on 510 jobs. Occupational vignettes provide students with opportunities to learn the nature of the work involved in particular occupations and with ways to receive occupational training. The first of three vignettes, "Secretary: Skills and Careers," allows the student to study secretarial tasks, career paths, pay scales, promotional ladders, and job requirements. Figure 56 shows how this vignette illustrates the relationship between a dictated letter taken in shorthand by a secretary and the corresponding typed transcription. The second vignette deals with the occupation of custodian, and the third deals with the retail sales clerk.

The counseling project has developed lessons that help students learn about general occupational concerns. "Job Benefits" introduces students to wage deductions and the range of benefits offered by many companies. This lesson simulates working at a job where benefits accrue. A sample pay stub is displayed, and students learn how deductions such as social security and federal taxes reduce the amount of pay they receive. Figure 57 shows a check stub that has typical deductions. This lesson also shows how job benefits function. For example, students learn how a company dental benefit may pay all or most of the cost of a trip to the dentist.

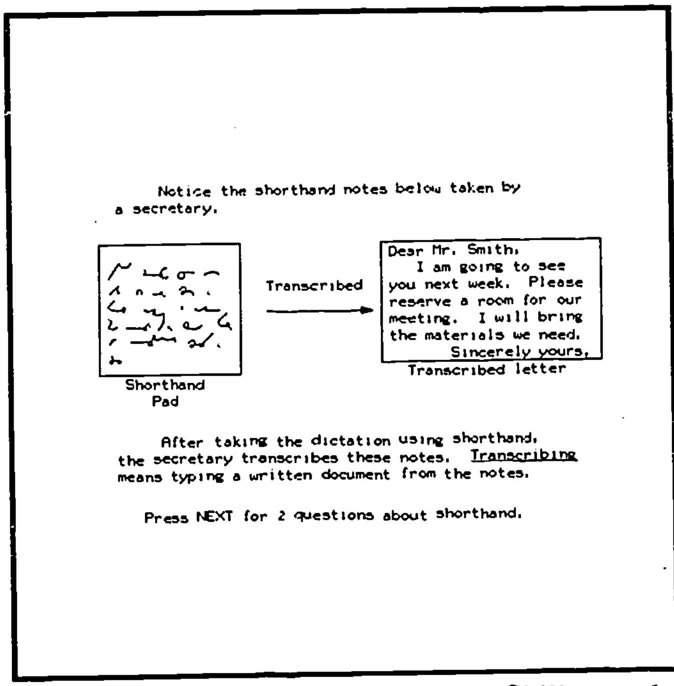


Figure 56. "Secretary: Skills and Careers," by James Morrison and Richard Sharf. Copyright© 1981, 1982 by the University of Delaware.

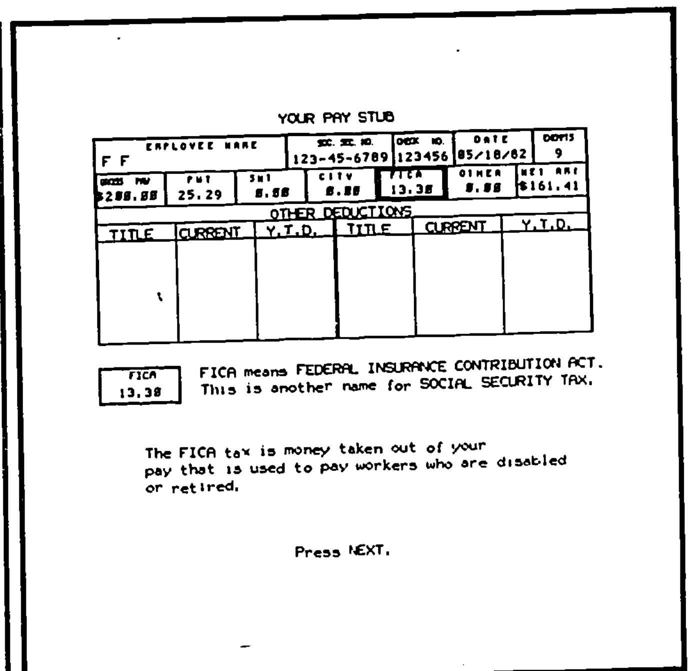


Figure 57. "Job Benefits," by Richard Sharf and Kathy Jones. Copyright© 1981 by the University of Delaware.

Also under development is a lesson dealing with career counseling. "Counseling for Career Decisions" allows students training as counselors to practice and learn appropriate vocational counseling techniques. Students are shown how to use specific counseling skills by responding to client situations in the lesson. Figure 58 shows a sample client statement and the choice of responses.

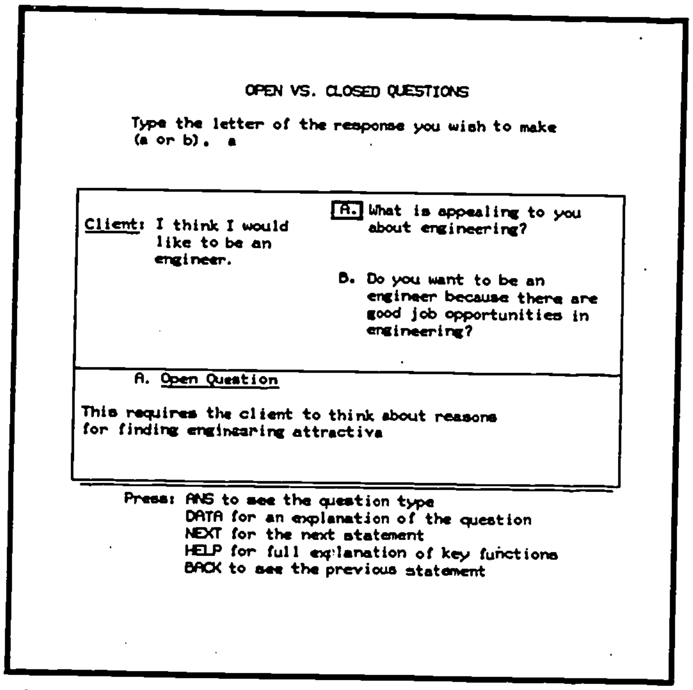


Figure 58. "Counseling for Career Decisions," by Richard Sharf and Louisa Frank. Copyright© 1982, 1983 by the University of Delaware.

Economics

Students in the Department of Economics are using two sets of PLATO lessons. The first set, developed at the University of Illinois, teaches basic macroeconomics and microeconomics. Under a joint agreement with the original authors, these lessons have been adapted to the University of Delaware curriculum. Discrepancies in terminology have been resolved, topics have been reordered or omitted, and explanations and graphs have been made easier to read. Figure 59 shows how graphs and questions are used in a lesson on profit maximization under conditions of imperfect competition to improve student comprehension of a complicated economic relationship. To reach the point shown in this lesson, the student has answered a series of questions about total cost, total revenue, average total cost, and demand. Each of these functions has been plotted at an appropriate place in the discussion. In response to the series of questions the student has answered, the total profit curve is about to be plotted on the top graph. This in turn will allow the student to read the point of profit maximization from the graph.

The second set of lessons was developed by the Department of Economics at the University of Delaware. These lessons include over 400 multiple-choice practice problems related to basic macroeconomics and microeconomics. Figure 60 is taken from one of these problems. The student has responded incorrectly and is being shown an explanation of the problem. Explanations are provided for all possible answers to each problem; students see only the explanations that are appropriate

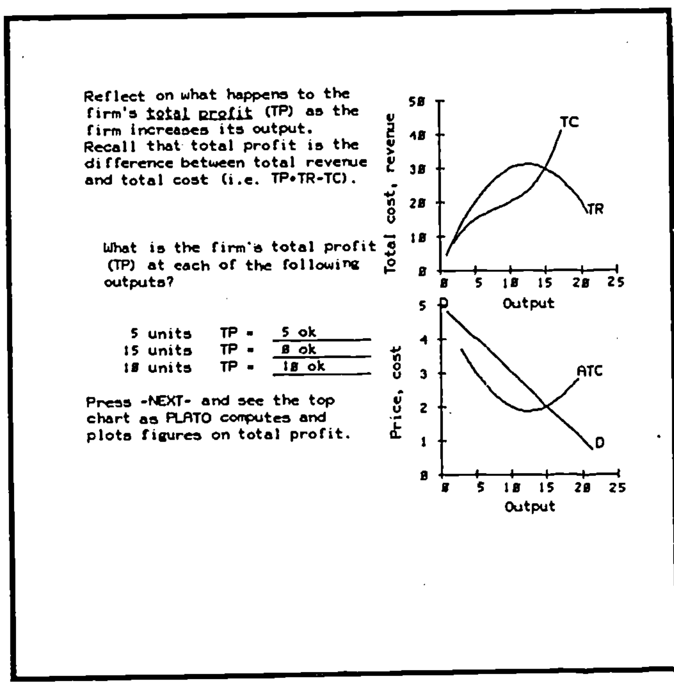


Figure 59. "Imperfect Competition," by Donald W. Paden, James H. Wilson, and Michael D. Barr. Copyright© 1975 by the Board of Trustees of the University of Illinois.

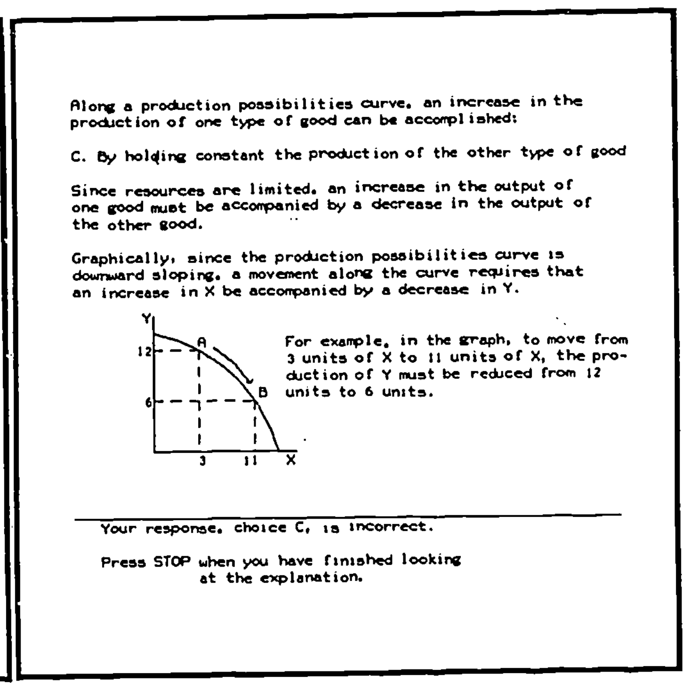


Figure 60. "Economics Practice Problems," by Jeffrey Miller, Charles Link, Lenore Pienta, Keith Slaughter, et al. Copyright© 1980, 1983 by the University of Delaware.

to their responses. In figure 61, a student has correctly answered a question on the marginal cost of producing. Upon pressing NEXT, the student will see the graphical representation of the problem. Upon successive NEXT presses, the graph will change to indicate the effect of changes in related economic parameters.

Research on the problem bank's use and its effect on student performance is being conducted. This research is a joint effort between the Department of Economics and the Instructional Resources Center. Data on student responses to questions in the test bank are being collected for a group of 300 students. The results of this research are being used to revise the problem bank to insure that all of the problems are demonstrably useful and challenging to University students.

To improve student understanding of the Federal Reserve System, the Center for Economic Education is developing a two-part software package on Apple microcomputers. Part I, "The Creation of Money," is a simulation that involves the mechanisms of money creation and fractional banking. Part II, "Monetary Tools of the Federal Reserve," presents three monetary policy tools and describes how each tool affects the expansion and contraction of the money supply; it concludes with problem-solving exercises to demonstrate the impact of monetary policy on the economy. The package will be used by the Center in its teacher training courses, and teachers will use it in high school economics, business, and American history courses.

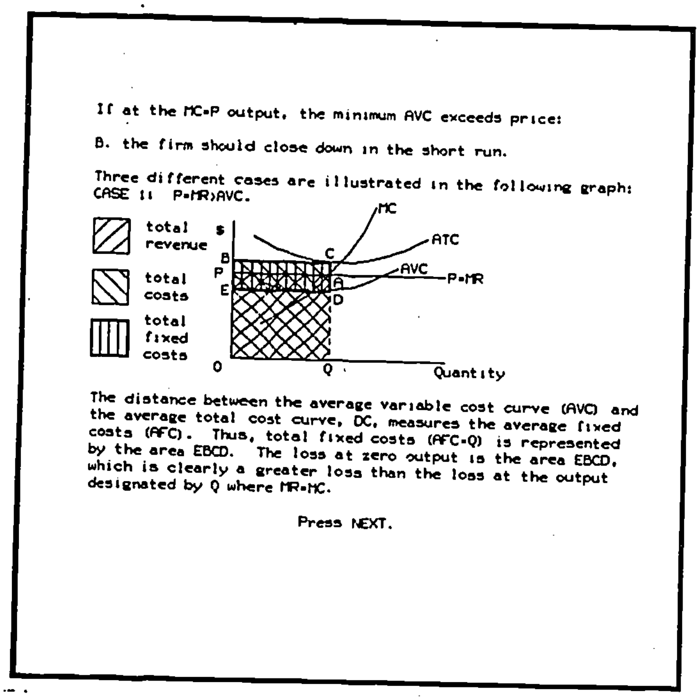


Figure 61. "Economics Practice Problems," by Jeffrey Miller, Charles Link, Lenore Pienta, Keith Slaughter, et al. Copyright© 1980, 1983 by the University of Delaware.

Education

The College of Education has been conducting research into the reading process, special education, statistics, and children's use of LOGO. A Master's Degree in Computer-Based Education has been established, and microcomputers have been integrated into the Reading Study Center and the Curriculum Development Laboratory. Several courses have used Apple II computers in the Willard Hall microcomputer classroom. These activities are discussed in turn as follows.

Research into the Reading Process

A research and development project is concentrating on computer simulations of reading, with the purpose of guiding the design of instructional and assessment programs.

Already operating on an IBM PC/XT is a fully integrated computer program based on the Just and Carpenter theory of reading comprehension. Subjects are engaged in a self-paced reading task in which they press a spacebar to produce successive words on the computer screen. Word-by-word reading times measured to millisecond accuracy are collected and later related to individual word properties, sentence, and text structures.

The Just and Carpenter paradigm has produced reading-time data resembling naturally occurring eye-fixation data. It has been shown to be extremely sensitive to the reading styles of children as well as adults and is being used to determine word processing style in different grade levels. The ability to assess a reader "on line" has also been demonstrated. Data collection, support software, and a menu system with a built-in editor provide a highly modifiable and expandable program.

A new approach to modeling the reader's cognitive function is being implemented on the VAX. Instead of a rule-based model wherein information is represented explicitly and is processed by means of productions, a parallel distributed model is being programmed to simulate more naturally the complex interactions that produce reading behavior. Work has begun on (1) analysis of the interaction of component neural subsystems in basic word recognition, and (2) design and implementation of corollary experiments on the IBM PC/XT to test these analyses. Some of the educational implications have been outlined in "Time, Now, for a Little Serious Complexity," by S. Farnham-Diggory, in Ceci, S. J., Ed, Handbook of Cognitive Social and Neuropsychological Aspects of Learning Disabilities (Hillsdale: Erlbaum, 1985).

Special Education

Research is being done to study social comparison behavior among mainstreamed handicapped children. All members of a third grade class that includes nine handicapped and twenty-six nonhandicapped students and two fourth grade classes with ten handicapped and twenty nonhandicapped students will have access to a terminal which will allow each member to check points received in a behavior management point system. When using the terminal, students will be able to access their own points as well as those of classmates who are participating in the study. The number of times handicapped students audit (access) scores of nonhandicapped students will be used as a measure of the extent to which these mainstreamed students are comparing their performance to that of their classmates. Comparison behavior of this kind is one of the expected outcomes of mainstreaming programs, and the project is aimed at developing a methodology for evaluating this aspect of mainstreaming.

Data relevant to this project were collected from two elementary schools in the Christina School District and have been coded and analyzed. A preliminary report will be available by August 1986.

Statistics

In the area of statistics, the education faculty has developed a Multi-Dimensional Scaling Survey Package that permits researchers to collect and edit data amenable to analysis by a state-of-the-art multidimensional scaling routine. The package presents stimuli, stores responses, and provides a number of visual displays that permit the researcher to assess the quality of data collected. After editing, the data can be routinely transferred for analysis using the ALSCAL program on the University's IBM 3081-D running under CMS. Using this set of routines, research that is ordinarily difficult to carry out can be done quite easily.

"The Effect of Sample Size on the Sample Variability of Pearson's Coefficient of Correlation" is a statistical sampling laboratory lesson that exploits the unique graphic capabilities of the PLATO system in order to allow students to examine the sampling variation of selected statistics and the relationship between such variation and sample size. This lesson has been used in several courses at the University. In addition to being a useful pedagogical tool, the sampling laboratory provides the potential for doing research on discovery learning.

Reading Study Center

The Reading Study Center has used a variety of drill and practice software, along with instructional games. Programs have included "Word Attack," "Comprehension Power," and "Story Trees" for the Apple, and "Ant Wars" and "How the West Was Won" on the PLATO system. In 1985, the Reading Study Center instituted the Intensive Literacy Program, which teaches the basics of English orthography to beginning and experienced readers; software is being designed and implemented on the IBM PC. Programs under development include "Scrambled Word," "Cookie Sheet," and several spelling and text-presentation drills for dyslexics. Students range from four-year-olds to college age.

Tutor LOGO

Tutor LOGO is a research-based learning environment designed to facilitate the study of how children learn computer programming. The system is composed of (1) a graphics subset of the LOGO programming language, (2) a protocol collection and presentation program, and (3) a complete on-line guide to the system, including component descriptions and a glossary of commands.

Instructional facilities include capabilities for viewing and commenting on student LOGO procedures and writing new commands for specific student groups; also included are educational games that give practice in Tutor LOGO skills. A student monitoring program displays a classroom map and a queue of help requests.

Figure 62 illustrates the Tutor LOGO display. Immediate mode or "Tell Mode" is shown. Students tell "Pogo," the Tutor LOGO turtle, commands that are immediately executed in the 400 by 400 pixel workspace. Students create procedures in an editor called "Tutor Mode." Procedures are saved automatically for future use. A sample procedure is shown in figure 63. Procedures take a structured format for easier learning, viewing, and debugging. Beyond the usual LOGO graphics commands, Tutor LOGO contains all trigonometric and mathematical functions available on the PLATO system. It supports complex, recursive functions and several looping structures.

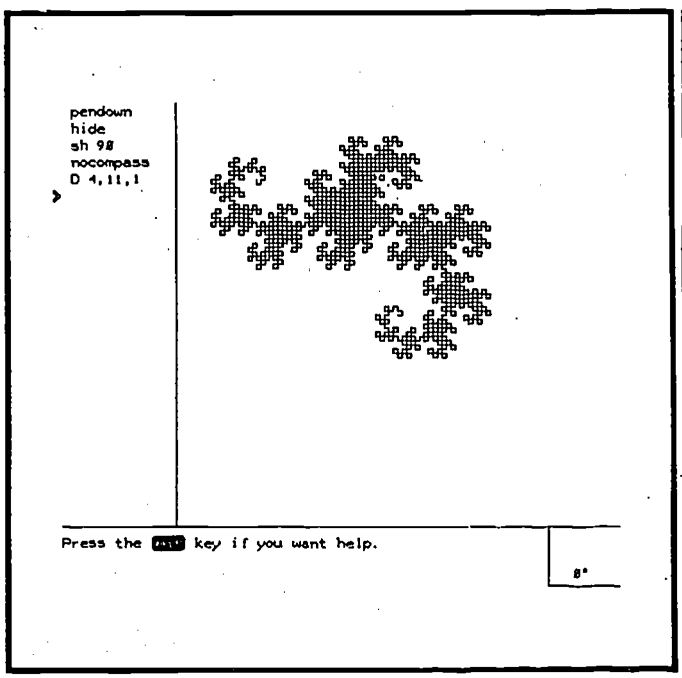


Figure 62. "Tutor LOGO," by Suzanne R. McBride, James W. Hassert, and Craig Prettyman. Copyright© 1982, 1983 by the University of Delaware.

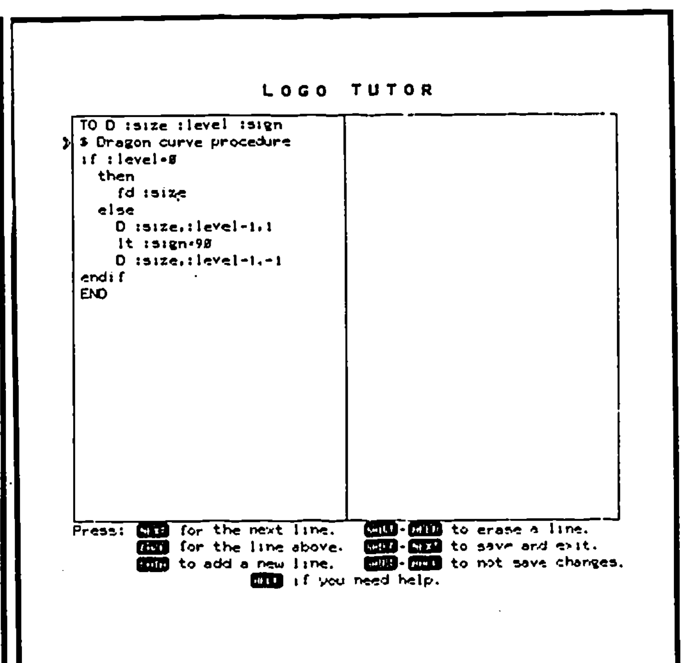


Figure 63. "Tutor LOGO," by Suzanne R. McBride, James W. Hassert, and Craig Prettyman. Copyright© 1982, 1983 by the University of Delaware.

Figure 64 shows a sample protocol from a child's programming session. Information in the header includes student name and group, date and time the session begins, and session number. Each time a command is typed and followed by a NEXT keypress, the typing is stored in the protocol along with the time elapsed since the session began. Other protocol information includes the informative messages received by the student, requests for help, indicators for when help is received, and the nature of the inquiry.

Separate pages can be accessed from the protocol to show the content of procedures before and after editing, as shown in figure 65. Another display shows a protocol of the actual keypresses involved in creating a procedure. The last screen of each protocol gives the count of all commands used within and between sessions.

Findings from the analysis of Tutor LOGO protocols have contributed toward an understanding of the cognitive processes of how children learn and solve problems in programming. A procedural model of these cognitive processes is being developed. Such a model can aid instructional and system design, particularly in constructing intelligent tutoring systems and computer-based cognitive modelling.

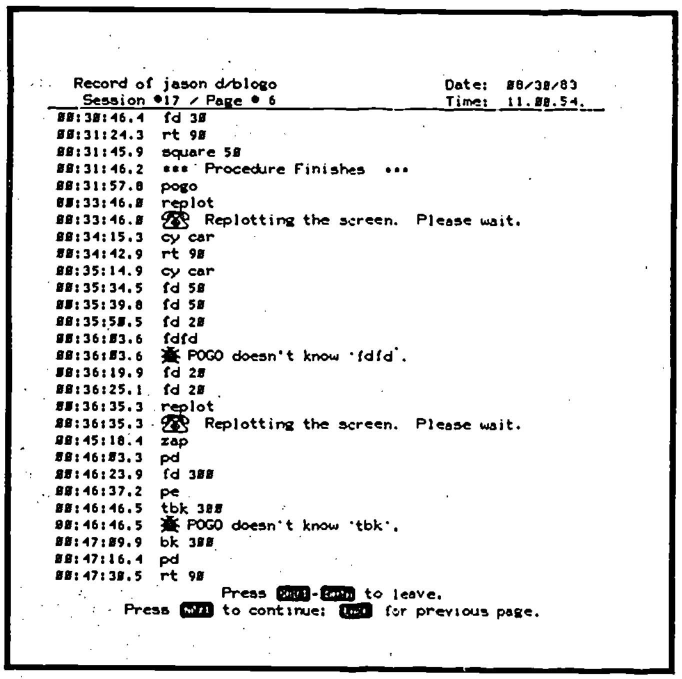


Figure 64. "LOGO Data," by Suzanne R. McBride, James W. Hassert, and Craig Prettyman. Copyright© 1983, 1984 by the University of Delaware.

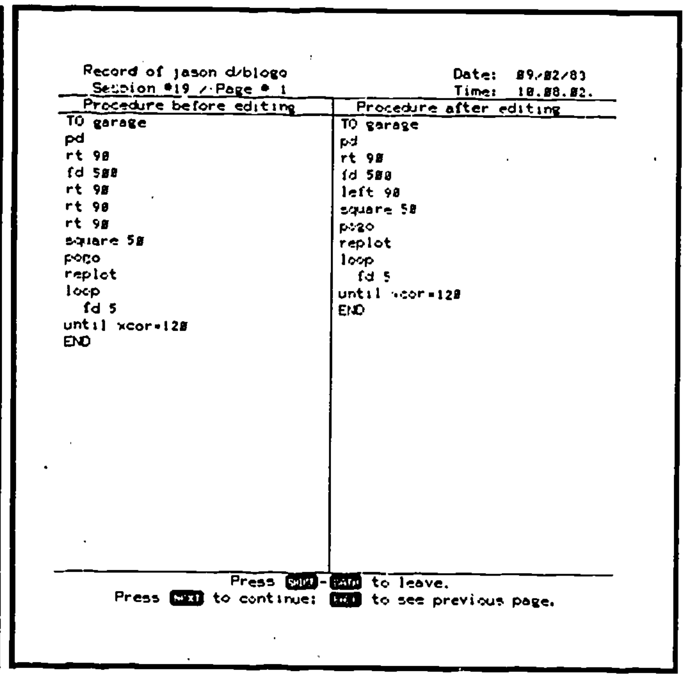


Figure 65. "LOGO Data," by Suzanne R. McBride, James W. Hassert, and Craig Prettyman. Copyright© 1983, 1984 by the University of Delaware.

Master's Degree in Computer-Based Education

A significant achievement in 1981-82 was the establishment of a Master's Degree in Computer-Based Education. Offered by the Department of Educational Studies, this program combines courses in educational research and educational computing with a variety of laboratory and field experiences that prepare graduate students for careers as professional designers and administrators of computer-based education projects. The program requirements are listed as follows:

Core Courses (12 credits)	Specialization (18 credits)
Educational Research Procedures	Introduction to Computer Instruction
Psychology of Teaching	Instructional Design of CBE
Pro-Seminar in Educational Psychology	Advanced Computer-Based Programming
Three-credit Elective	Six Credits of Computer Science
	Master's Thesis/Research Project

Curriculum Development Laboratory

The Curriculum Development Laboratory opened in the fall of 1984. It contains five Apple IIe Color Starter systems and printers. The purpose of the laboratory is to show teachers and children in grades K-3 what can be done with microcomputers in a traditional classrooom setting. Teachers use the lab to plan and test curriculum ideas that provide enrichment in science and mathematics. Public school classes come for two-week or three-week sessions, spending two hours per day, five days per week in the program. Students are both pretested and posttested. Parents fill out a questionnaire that asks what previous experience the children have had with microcomputers; this information is used to adjust programs for experienced users. The lab features LOGO and the word processing programs "Bank Street Writer" and "Magic Slate." Students use the word processors to record the day's events, printing a report to take home and leaving one in the lab.

Apple Classroom and Microcomputer Demonstration Site

In the fall of 1984, Dr. Ralph Ferretti used Apple II microcomputers to test theories in memory, recall, and recognition. Education majors received extra credit for participating. Dr. Ferretti presented the results at the CIRCLe Retreat.

In the spring of 1985, students from the Introduction to Microcomputer Software course learned "Visicalc®," "dBASE II," and "WordStar" on the Apple. Students taking the course Elementary Curriculum: Reading learned the "Bank Street Writer" program. In both the fall of 1984 and the spring of 1985, future teachers from the course Elementary Curriculum: Math reviewed elementary mathematics software on the Apple to learn what programs are appropriate for elementary math classrooms. Two popular programs used in this class were "Rocky's Boots" and "Bumble Plots." Figure 66 shows how "Rocky's Boots" enhances a child's logic skills. First, the child learns how to move the cursor through various rooms. Then the child learns how to create machines that operate on the basis of logic. The child subsequently scores points by using the machines to "boot" the correct objects. Figure 67 shows how "Bumble Plots" enhances the student's ability to plot numbers on a graph.

In the fall of 1985 and the spring of 1986, a variety of methods courses offered by the College of Education used the Apple classroom to learn about social science, mathematics, reading, and physical science software. More than 400 students learned how to use, evaluate, and integrate the software into an existing curriculum. In the Microcomputer Demonstration Site, students were exposed to many popular microcomputer systems and videodisc technology.

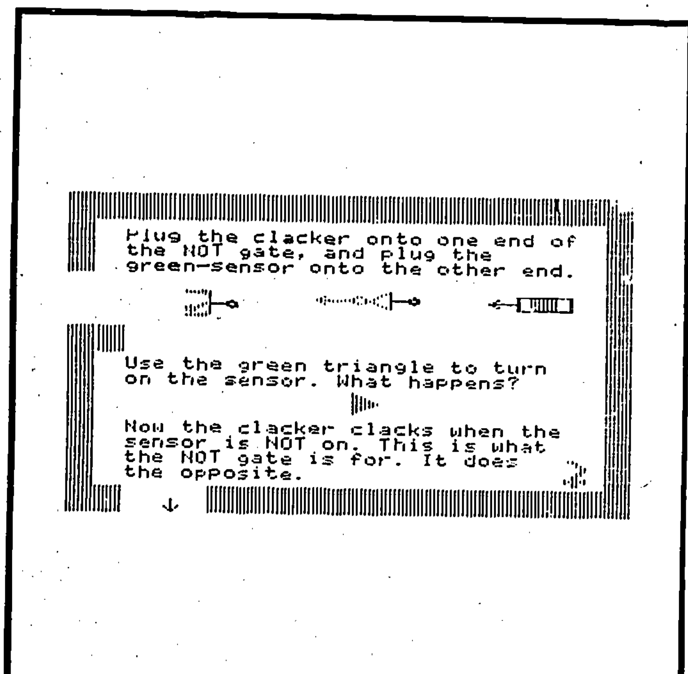


Figure 66. "Rocky's Boots," by The Learning Company. Copyright© 1982 by the Learning Company. Used with permission.

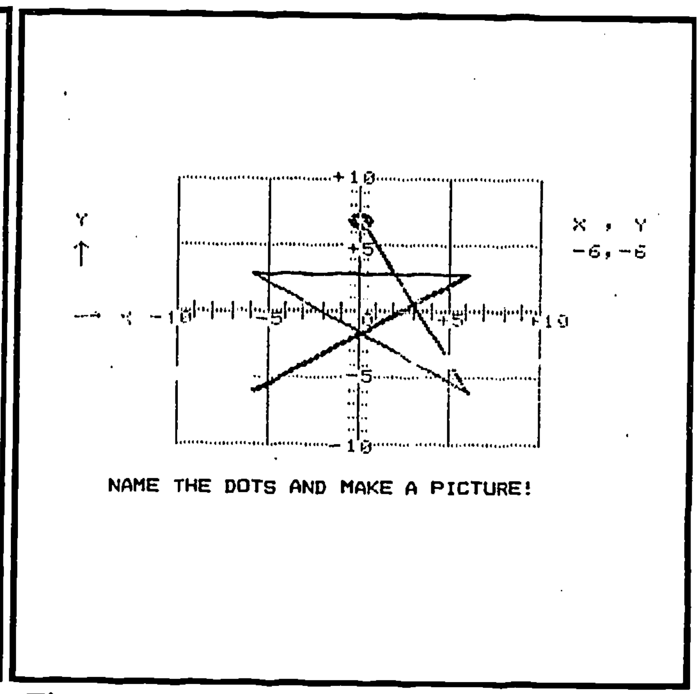


Figure 67. "Bumble Plots," by The Learning Company. Copyright© 1982 by the Learning Company. Used with permission.

Visicalc® is a registered trademark of Visicorp.

Engineering Graphics

In the fall of 1985, students in Engineering Graphics began using software on the IBM PC. One hundred students attended a seminar accessing software over the 3COM network, which uses coaxial cable to link ten PCs to a file server and printer. Students completed assignments in WordPerfect, Microsoft FORTRAN, and IBM BASIC and attended an introductory seminar on network use. Figure 68 shows the initial page of instructions students see when they sign on. Figure 69 is a help display which provides information on the use of the network and lists the available software.

```
When the red light on drive A (the drive on the left) goes off, please
return the network boot diskette to its folder on the wall and then place
your own working diskette in drive A.

Help is available by typing "help" at the DOS prompt "A>".  Remember to
press the ENTER key (marked with     ) after typing each command.

Before you leave, please type "bye" at the DOS prompt.


A>
```

Figure 68. Introductory Display for Users of the 3COM Ethernet in the Colburn Laboratory IBM PC Classroom.

```
Instructions for Using Software Available in Colburn Classroom

     1. To use a program listed on the next pages, type the
        corresponding file name after the "A>" prompt and then
        press the ENTER key.  For the programs which show
        [filename], before pressing ENTER you may type a space
        and the name of your file.

     2. Programs marked with an * require a diskette which can be
        signed out from the classroom assistant.

     3. Manuals, templates, and reference cards may also be
        signed out by presenting identification to the classroom
        assistant.  Only University of Delaware identification
        cards will be accepted.

Press any key for a listing of the available programs.


-- More --
```

Figure 69. Portion of the Software Listing Available to Users of the 3COM Ethernet in the Colburn Laboratory IBM PC classroom.

English

One of the four sections of the Writing Program in the Department of English continues extensive use of PLATO lessons, while word processing on microcomputers has gained in popularity in all four sections.

Mainframe PLATO Lessons

The Writing Center has found the PLATO system to be a valuable tool for improving writing skills. Students use PLATO lessons developed at the Universities of Delaware and Illinois to gain expertise in the use of punctuation, sentence structure, spelling, paragraph structure, verbs, and verb forms.

The Writing Center has developed a package of lessons that teach classroom English language skills. The package includes a diagnostic test and four tutorial lessons covering language features common to speakers of inner city dialects. These features include multiple negation, copula deletion, "s" endings on verbs, and the habitual "be." After taking the diagnostic test, students are branched to appropriate tutorials.

Figure 70 shows an introductory screen display from a lesson that teaches third person verb endings. The distinction between informal and classroom English is emphasized in all four tutorials.

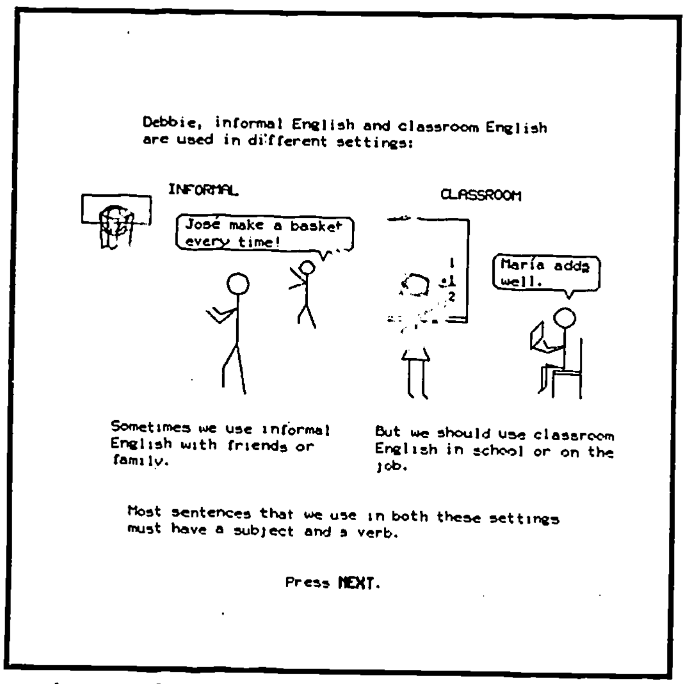


Figure 70. "'S' on Third: When to Put an S on a Verb," by Louis A. Arena, Phyllis N. Townsend, and Jean Patchak Maia. Copyright© 1980 by the University of Delaware.

Figure 71 shows an exercise from a lesson that teaches students how to construct classroom English negative sentences. Students are asked to find the sentences that contain multiple negatives. After they choose a sentence, the students are told whether they have correctly spotted an informal English sentence and are given the opportunity to change incorrect responses. When the students have successfully spotted all informal English sentences, the lesson changes the sentences to conform to correct classroom English.

Word Processing on Microcomputers

The Department of English has increasingly relied on word processors for teaching composition. The growing number of IBM PCs on the campus is allowing students to take advantage of pre-writing, editing, and style analysis software.

Heaviest use is in nine sections of the Freshman Critical Reading and Writing course, in which students are assigned to use WordPerfect on the IBM PC. The Writing Center also uses WordPerfect in its remedial English Essentials class. Word processing is also used in the upper-division Problems in Composition and Advanced Composition course and in Written Communications in Business.

During 1985, OCBI worked with the Department of English to collect a plethora of commercial packages that are being used to improve student typing, grammar, and outlining skills. The IBM PC program "Personal Bibliographic Systems" is used extensively in all classes to enhance the student's ability to produce an accurate bibliography for a composition.

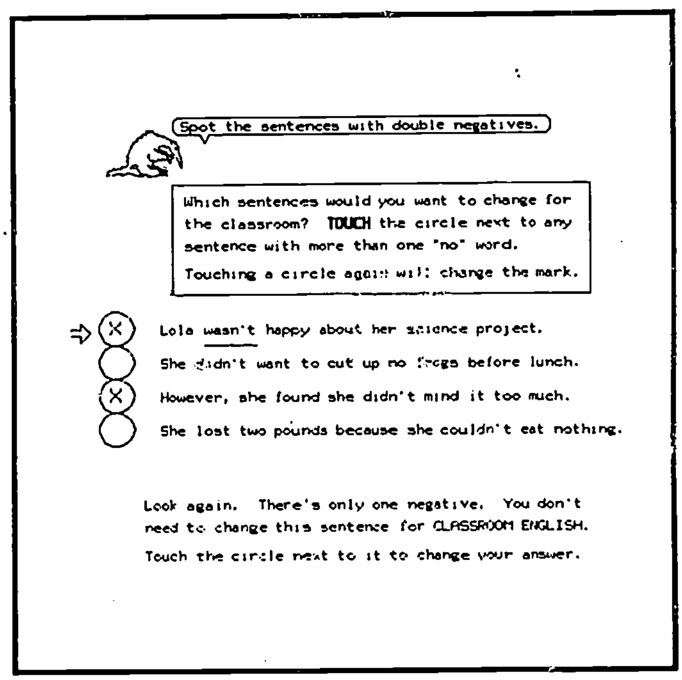


Figure 71. "The Power of Negative Thinking: Using Negatives in Classroom English," by Louis A. Arena, Sophie Homsey, Jessica R. Weissman, and Rae D. Stabosz. Copyright© 1979, 1980, 1981 by the University of Delaware.

Geography

The Department of Geography is developing a package of lessons on the IBM PC to improve instruction in cartographic design and map layout. Using the PC's graphics features, students will be able to create and alter maps interactively on the computer screen, move various map elements or increase and decrease their size by using cursor control keys, and plot a color print of the finished map for later reference and grading. In a matter of minutes, students can make maps that would take hours to complete on paper. Students not only make maps of a higher quality, but they also develop a better aesthetic judgment, since the lesson makes it easy for them to alter their map designs and change parts while retaining the remainder of the design.

Beginning students using the program "Layout Exercise Five: Name Placement" are given the map shown in figure 72 and are asked to correct the size, rotation, and placement of the names of the states. Advanced students draw complete maps of their own.

OCBI is also matching funds from an Improvement of Instruction Grant to develop a "place-name" geography package. Students are taught the oceans and continents of the world, but the package focuses mainly on North America and the United States in particular.

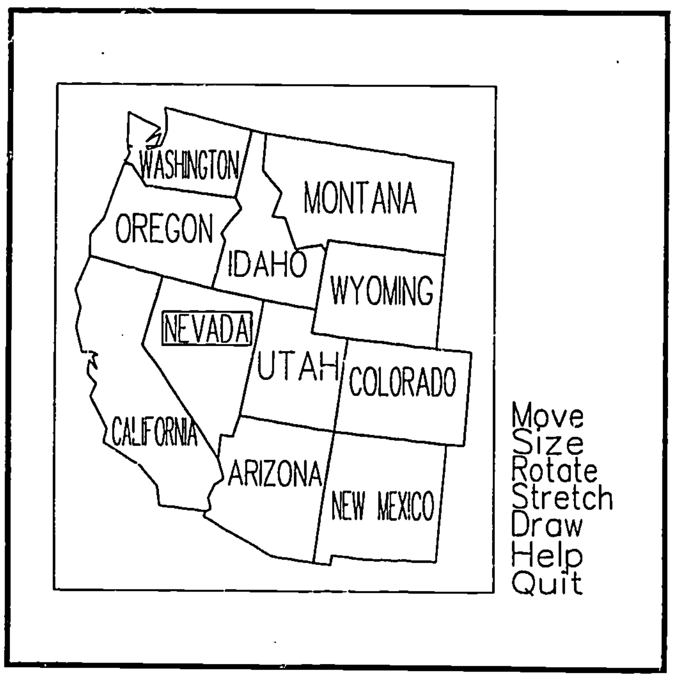


Figure 72. "Layout Exercise Five: Name Placement," by Frank Gossette, Carol Jarom, and Paige Vinall. Copyright©1986 by the University of Delaware.

Geology

To improve understanding of the process of sedimentation, the Department of Geology has developed a lesson called "The Sedimentology of Flood Deposits" on the IBM Personal Computer. After teaching terminology and the effects of individual parameters on the outcome of floods, this lesson enables students to observe the effects of combinations of parameters.

Through use of the color graphics on the IBM PC, a variety of screen displays and graphs enable students to grasp quickly each parameter's contribution to the overall process. For example, students are asked to choose a number of grain sizes for sand, silt, and clay particles; each grain moves down the screen with the velocity at which it would fall in still water. The instruction is highly interactive; students may repeat the experiments as often as they wish, changing values and immediately observing results. The lesson builds on the information learned from the experiments, presenting a variety of graphs and questions to enable the students to apply what has been learned to different sets of circumstances. The question shown in figure 73 concerns lateral deposition across a flood plain.

Building on results obtained from experiments with single parameters, the lesson produces a graphic simulation showing the thicknesses and characteristics of deposits as they accumulate in a floodplain after many floods. One outcome of the simulation is shown in figure 74. By choosing to vary as many as five parameters, students gain an understanding of floodplain interactions.

Geology students in an Earth Science course are also using a program called "Volcanoes" on the Apple computer. Published by Earthware Computer Services, this program is a simulation that allows students to predict volcanic eruptions.

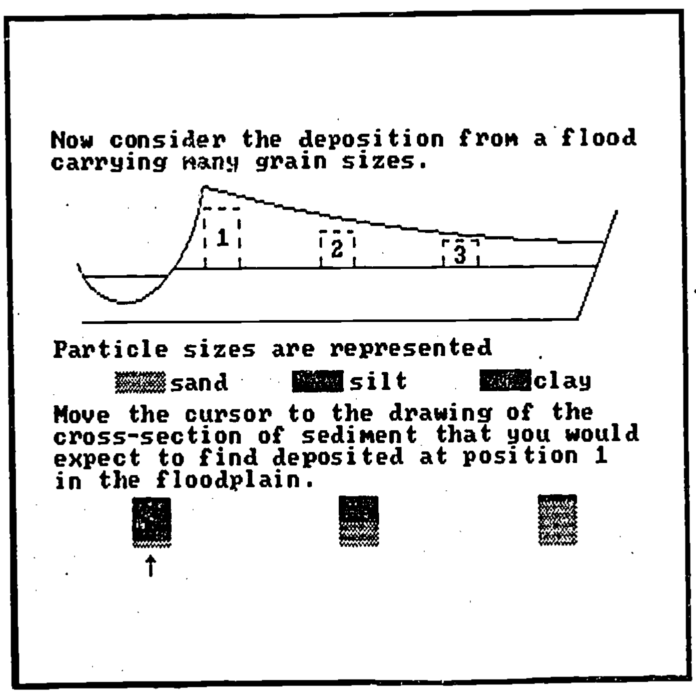


Figure 73. "The Sedimentology of Flood Deposits," by James E. Pizzuto, Nancy J. Balogh, Michael Frank, Bec Hamadock, David McNeely, and Anne S. O'Donnell. Copyright© 1986 by the University of Delaware.

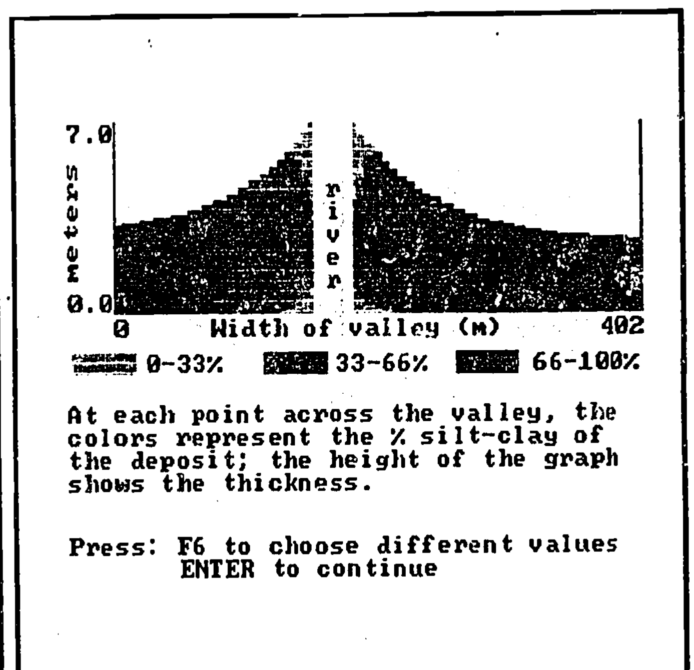


Figure 74. "The Sedimentology of Flood Deposits," by James E. Pizzuto, Nancy J. Balogh, Michael Frank, Bec Hamadock, David McNeely, and Anne S. O'Donnell. Copyright© 1986 by the University of Delaware.

Honors

The PLATO system became part of the Freshman Honors Program in Dover during the spring semester of 1978. With four terminals installed on the Wesley campus, it became a very popular part of the program. Use among the students and staff took several forms. In addition to using PLATO lessons in their classes, some of the students were interested in programming their own lessons. Fifteen honors students became lesson authors. They learned to display drawings, to compose music, and to program animations.

Several honors faculty members became PLATO authors and designed lessons to be used by their students. One lesson designed for class use plots a vector field V = M(x,y)i + N(x,y)j. Students are asked to supply functions M and N. Any valid expressions in x and y may be used. Figure 75 shows the plot of the corresponding vector field. Another faculty lesson written in a game format teaches polar coordinates. In this game, students must aim the cannon of a tank at a target and fire the proper distance to score a hit. Students aim the tank by guessing the polar coordinates (r,0) of the target. If the target is hit, points are awarded. The goal is to score 4,000 points in twenty shots. Some targets are worth more than others, based on the difficulty of the coordinates and the size of the target. Figure 76 shows the result of hitting a target with coordinates (62,677).

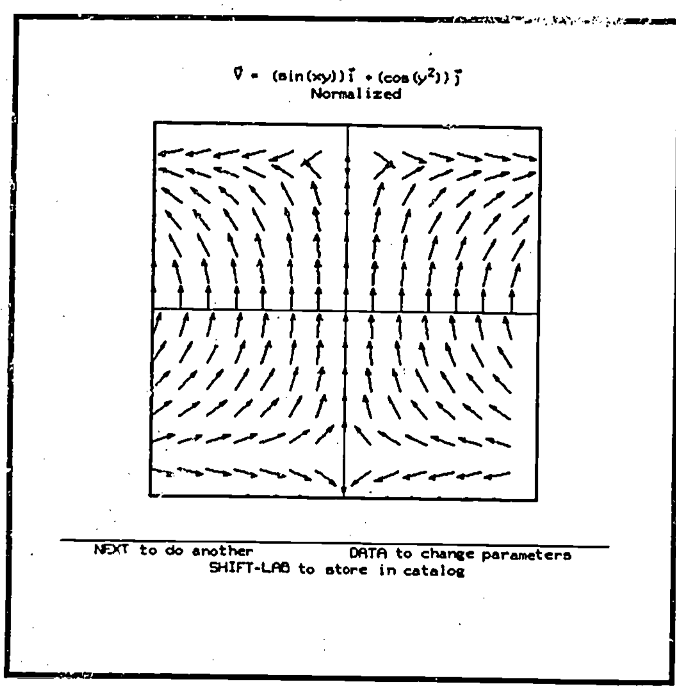


Figure 75. "Vector Field Plotter," by Morris W. Brooks. Copyright© 1978 by the University of Delaware.

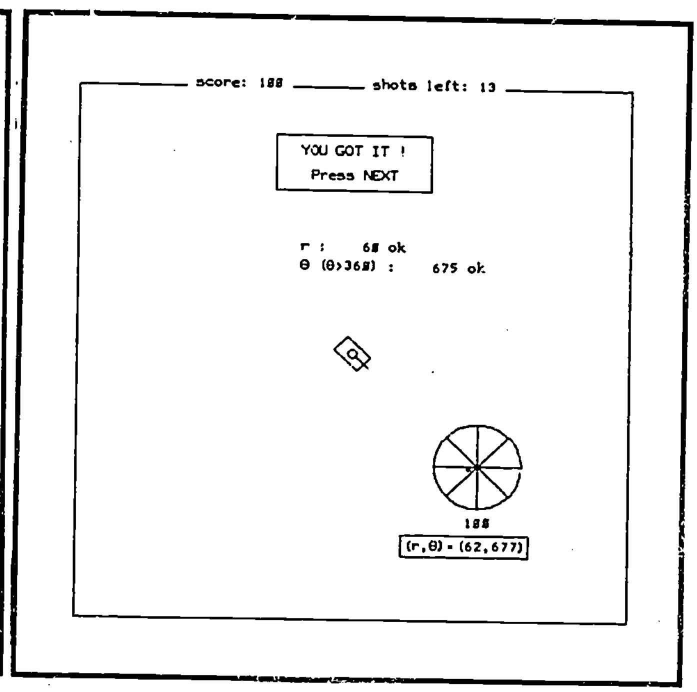


Figure 76. "Polar Coordinates," by Alan Stickney. Copyright© 1985 by the University of Delaware.

Figure 77 shows a sample display from a logic lesson. Students enter premises and conclusions in standard logical notation. The lesson then analyzes the logical argument, checks its validity, and responds with a judgment on the validity of the argument. This lesson also reviews basic concepts in symbolic logic.

Figure 78 shows a sample display from a lesson that graphically illustrates the Cauchy-Euler method of numerically approximating the solution of an ordinary differential equation. Students are asked to supply a function in two variables f(t,x) and initial conditions. The lesson responds by displaying the graph of the approximating solution. This lesson is useful in studying qualitative properties of differential equations for which it is difficult to obtain analytical solutions.

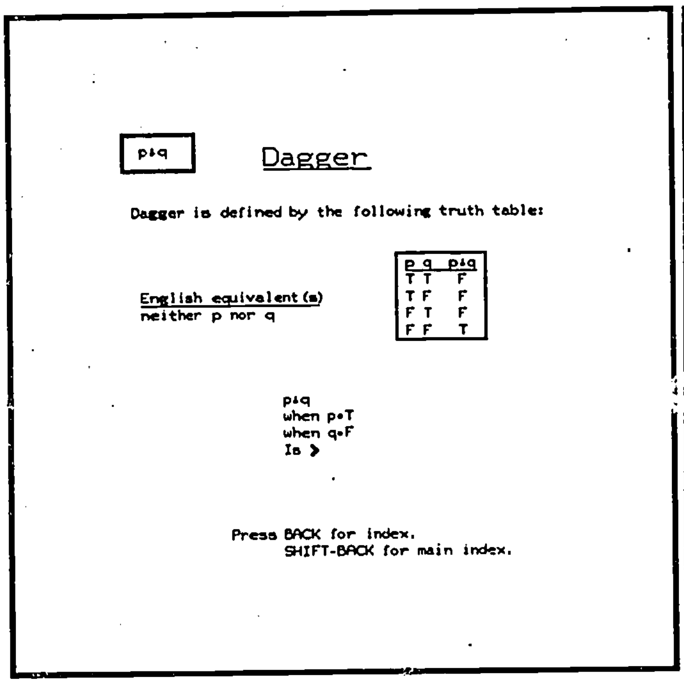


Figure 77. "Logic," by Gerard C. Weatherby and Robert Scott. Copyright© 1978 by the University of Delaware.

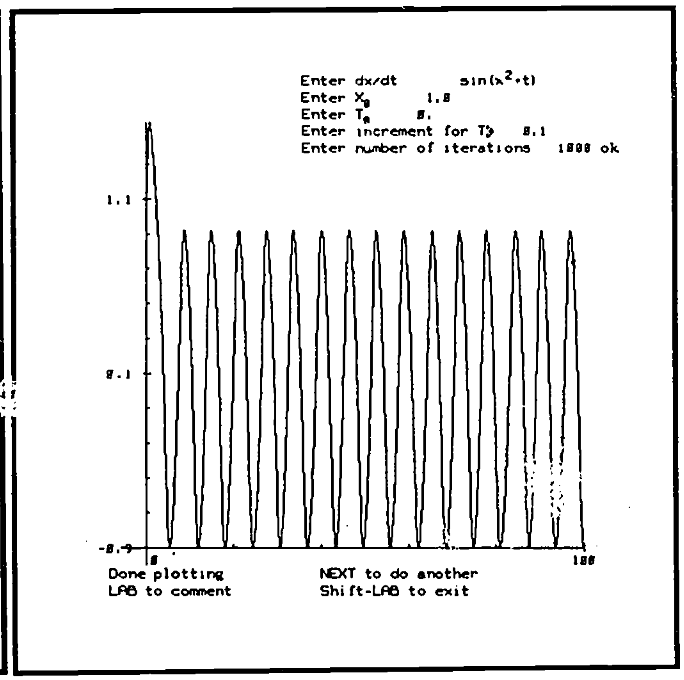


Figure 78. "The Cauchy-Euler Method of Approximating Differential Equations," by Tanner Andrews and Stanley Samsky. Copyright© 1979 by the University of Delaware.

During the 1979-80 academic year, the Freshman Honors Program moved to Newark, where an Honors Center was set up as part of the University Honors Program. PLATO terminals were installed in the honors library/study area. Students completed assignments for various courses, programmed lessons, and used the PLATO system as a resource for independent or remedial study.

To encourage independent study, a package of basic skills calculus lessons was written to allow students to practice until a particular type of problem is mastered. The "Calculus Basic Skills I" lesson, designed for students in a beginning calculus course, provides practice in finding derivatives of elementary functions. Polynomials, reciprocal powers, exponentials, and trigonometric functions are included. Figure 79 shows a practice session on polynomials. Diagnostic feedback is provided in anticipation of the most common errors. The "Calculus Basic Skills II" lesson provides drill in elementary anti-derivative problems. These problems are divided into groups that deal with concepts like monomials, polynomials, and signed exponents. Figure 80 illustrates a test on exponentials. Students are given two tries on each question and are considered to have mastered a topic when they attain a score of eighty percent.

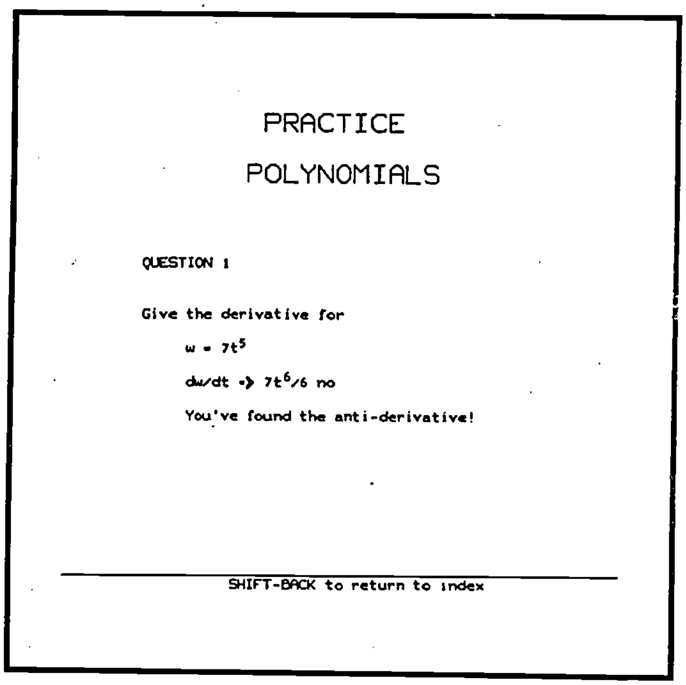


Figure 79. "Calculus Basic Skills I," by Morris W. Brooks. Copyright© 1978 by the University of Delaware.

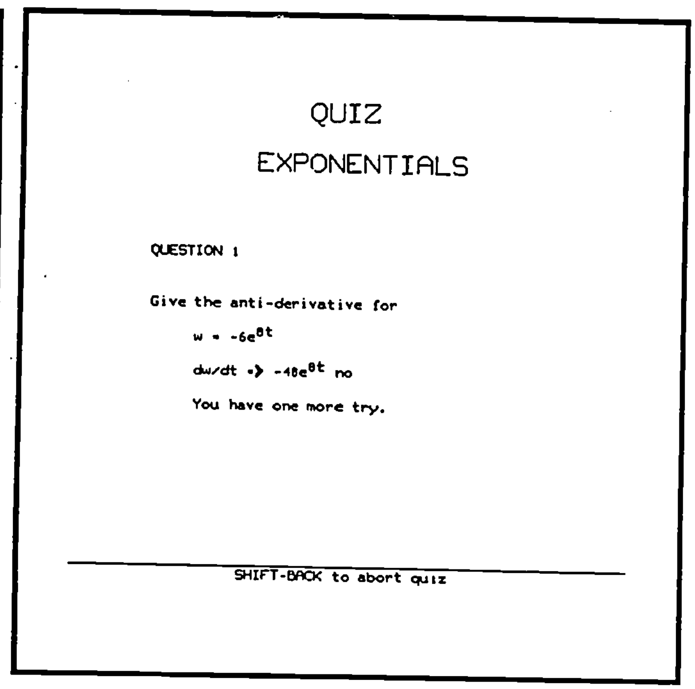


Figure 80. "Calculus Basic Skills II," by Morris W. Brooks. Copyright© 1978 by the University of Delaware.

Another honors use of the PLATO system is exemplified by a ten-minute film created by a student while working with a professor on a research grant. Entitled "Four-Dimensional Rotations," this film uses PLATO graphics to illustrate complex mathematical ideas by showing photographs of shapes and functions rotating on the screen. Figures 81 and 82 show a hypercube and a hypersphere, both of which are rotated in the film.

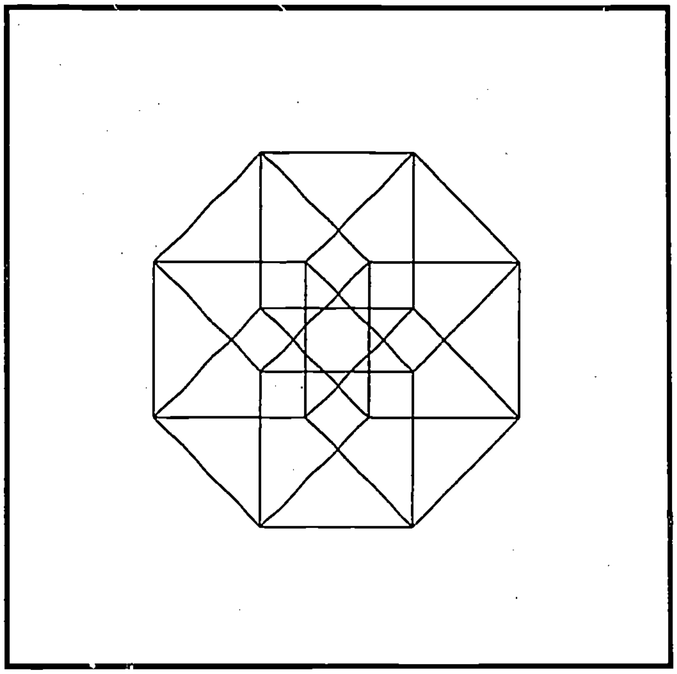


Figure 81. "Four-Dimensional Rotations," by Paul E. Nelson. Copyright© 1980 by the University of Delaware.

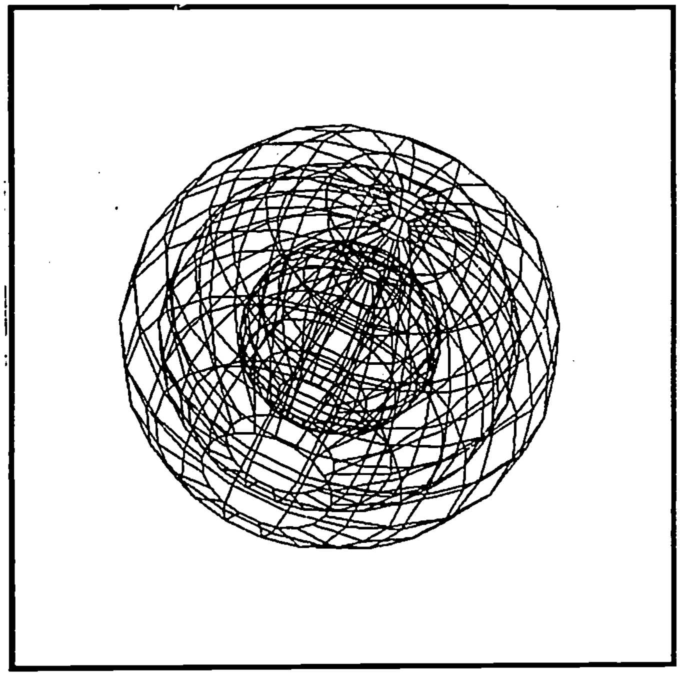


Figure 82. "Four-Dimensional Function Plotter," by Paul E. Nelson. Copyright© 1980 by the University of Delaware.

Human Resources

The faculty of the College of Human Resources has been extremely active in the field of CBE and is taking advantage of the teaching and research potential of the PLATO system. Microcomputers are also being used. Activities in each department are discussed in turn as follows.

Food Science and Human Nutrition

In the area of nutrition, lessons are being developed on the PLATO system that deal with weight control and nutritional management of diabetes mellitus. The weight control lessons discuss the metabolic basis of weight control and the short and long-term implications of hazardous dietary regimens. The nutritional management lessons allow students to calculate the energy needed for a hypothetical patient so that they can plan the patient's diet. The chart in figure 83 shows how students calculate the amounts of various kinds of foods in terms of carbohydrate, protein, fat, and energy content, according to the energy requirements of the patient.

A series of lessons dealing with the metabolism of carbohydrates, proteins, and fats is also being developed. Students review steps in the metabolic pathways for the major nutrients, with an emphasis on hormonal, enzymatic, and substrate regulation. In figure 84, a student has correctly answered a question on regulation of the reaction catalyzed by glycogen synthase and is about to add this information to the

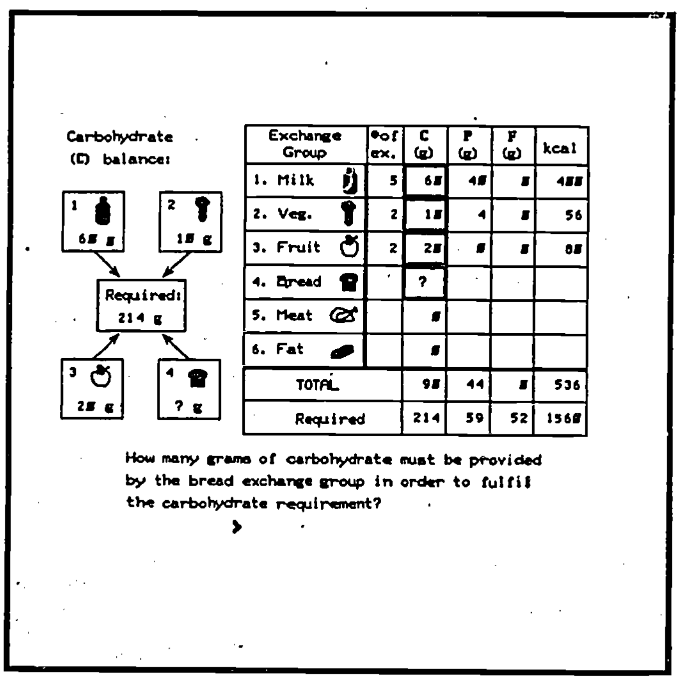


Figure 83. "Use of the Exchange System in Meal Planning," by Leta P. Aljadir, Jeffrey B. Snyder, Evelyn V. Stevens, and Miriam Greenberg. Copyright© 1986 by the University of Delaware.

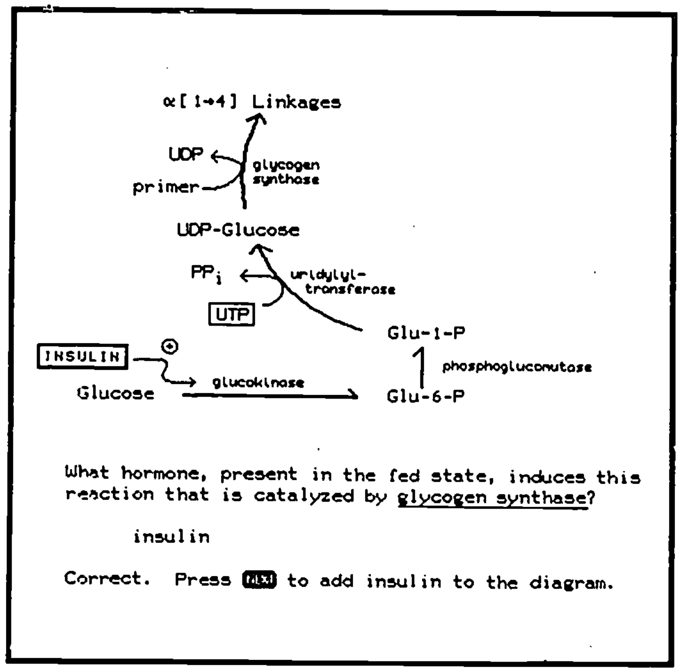


Figure 84. "Carbohydrate Metabolism, Part II - Glycogenesis/Glycogenolysis," by Leta P. Aljadir, Kathleen C. Fanny, Miriam Greenberg, Evelyn V. Stevens, and Kathleen D. Troutman. Copyright© 1986 by the University of Delaware.

diagram. Figure 85 shows the final diagram for the metabolism of glycogen, which is the stored form of carbohydrates in humans.

Students are using the IBM PC to run programs such as "Nutritionist II," "West Nutrition Analysis Program," "Nutrient Tracker," "WordPerfect," and "Lotus 1-2-3. "Students also use an Apple program called "Eat Smart." Published by Pillsbury, the "Eat Smart" program allows students to enter their diets and then proceeds to analyze the diets, informing students when essential nutrients are lacking.

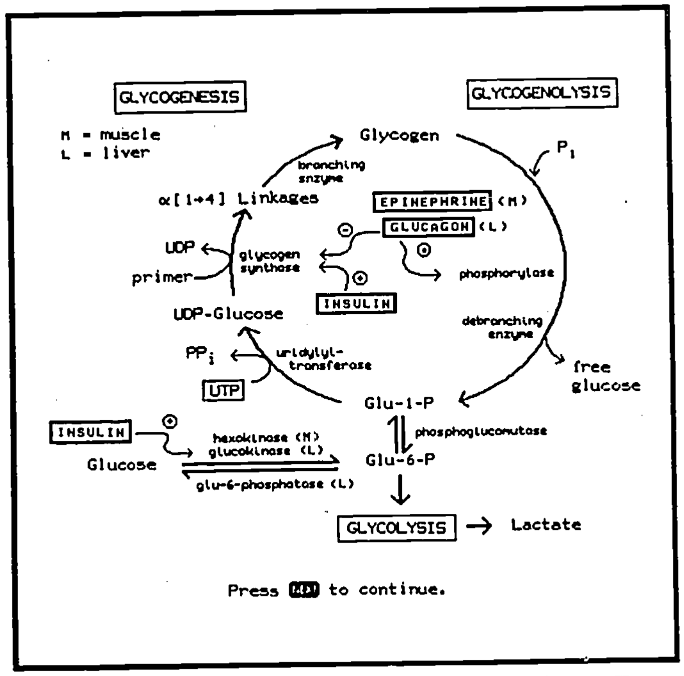


Figure 85. "Carbohydrate Metabolism, Part II-Glycogenesis/Glycogenolysis," by Leta P. Aljadir, Kathleen C. Fanny, Miriam Greenberg, Evelyn V. Stevens, and Kathleen D. Troutman. Copyright© 1986 by the University of Delaware.

Individual and Family Studies

The Computer Active Preschool Program (CAPP) is designed to develop a model for the orientation and use of computers as interactive instructional tools for use with preschool children. A primary objective is to integrate the computer into preschool classroom activities. Visual aids and related classroom materials have been developed to introduce young children to computers.

As part of the CAPP program, two computer camps are held each summer. Three major goals are to provide the following:

-a developmentally appropriate computer experience for young children
-a high quality computer education program for inservice and preservice teachers
-a research site for faculty, staff, and graduate students.

As part of CAPP, children (1) learn to use a variety of microcomputers and peripheral devices, (2) develop beginning keyboarding skills, (3) learn to use computer software that is developmentally appropriate, and (4) receive an introduction to LOGO programming and word processing. Children are also exposed to general computer concepts through interactions associated with everyday events in their environment.

CAPP is on the leading edge of exposing young children to computer technology. By emphasizing the use of the computer as a means of creative expression, it is hoped that the program can continue to lead the way in exploring new avenues in which young children can benefit from computer technology. With this in mind, the CAPP curriculum is being expanded to incorporate the computer as a tool. This includes its use in the areas of art, music, animation, programming, and writing. The use of computers in conjunction with video technology is another means of creative expression CAPP hopes to explore with young children.

Textiles, Design and Consumer Economics

A series of eight clothing construction lessons is being developed and revised. Topics include metric measurement, body measurement, pattern measurement, ease requirements, alteration practice, fitting, determining pattern size and figure type, and determining needed alterations.

One of the criteria in lesson development has been to make full use of the special features of the PLATO system. PLATO's graphing capabilities are used in many of the clothing construction lessons, including the lesson on body measurement. Figure 86 shows how the student is presented with a line drawing of a male or female figure with three sets of points. The student is asked to specify the correct set of points for a given measurement. The student may press HELP to clarify the location of any measurement. The student's answer is judged correct or incorrect, and meaningful feedback is given when errors are made.

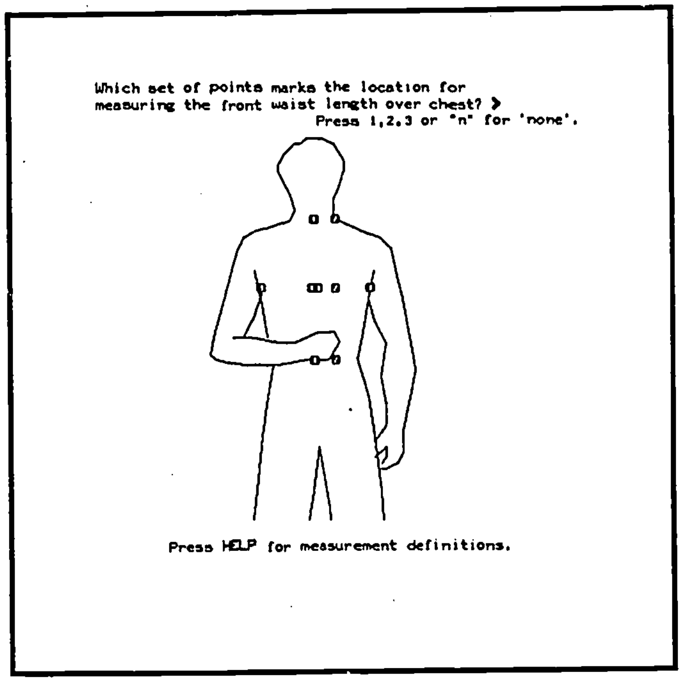


Figure 86. "Body Measurement," by David G. Anderer, Kathleen Bergey, Dorothy Elias, Frances W. Mayhew, Bonnie A. Seiler, and Frances Smith. Copyright© 1977, 1978, 1979, 1980 by the University of Delaware.

The Consumer Economics project has completed a "Consumer in the Marketplace" package of thirty-two lessons that focus on (1) the process of efficient consumption, (2) the analysis of income generating alternatives, and (3) the study of expenditure patterns of today's consumers for maximizing satisfaction. Sixteen PLATO Learning Management (PLM) lessons interact with sixteen TUTOR lessons and test student knowledge of subject content. The target population consists of college sophomores and juniors.

Each program presents an important consumer economic concept. For example, figure 87 shows how the rationality lesson illustrates planned behavior during the purchasing cycle. The intelligent use of the four processes of rationality--inquiry, valuing, decisioning, and acting--result in efficient consumption.

In figure 88, the transfer of income lesson analyzes consumer behavior; the graph shows the relationship of expenses and income to an individual's age. Other lessons in the package cover consumer education topics such as information gathering, decision matrix analysis, the consumer price index, the time-probability concept, sovereignty, opportunity cost, investment in human capital, consumer delivery systems, the optimal consumption stream, and the concept of product liability.

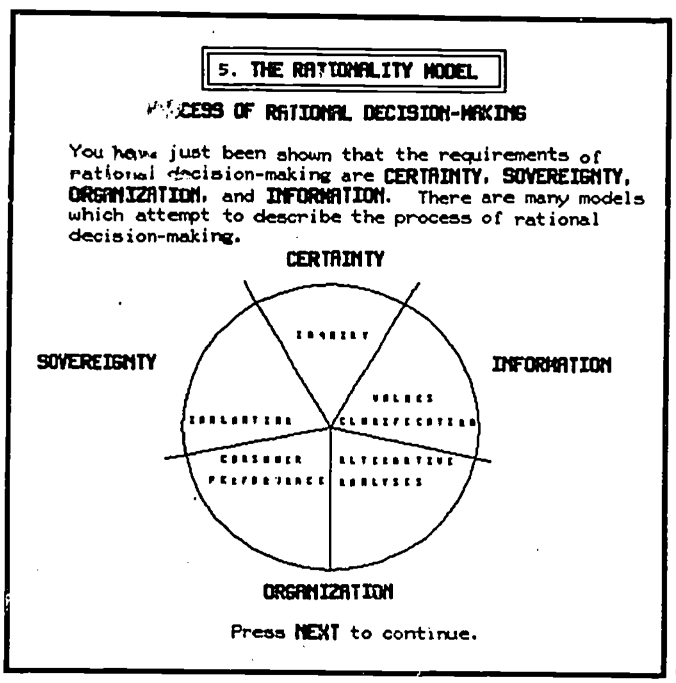


Figure 87. "Consumer in the Marketplace Topic: Rationality," by James Morrison. Copyright© 1986 by the University of Delaware.

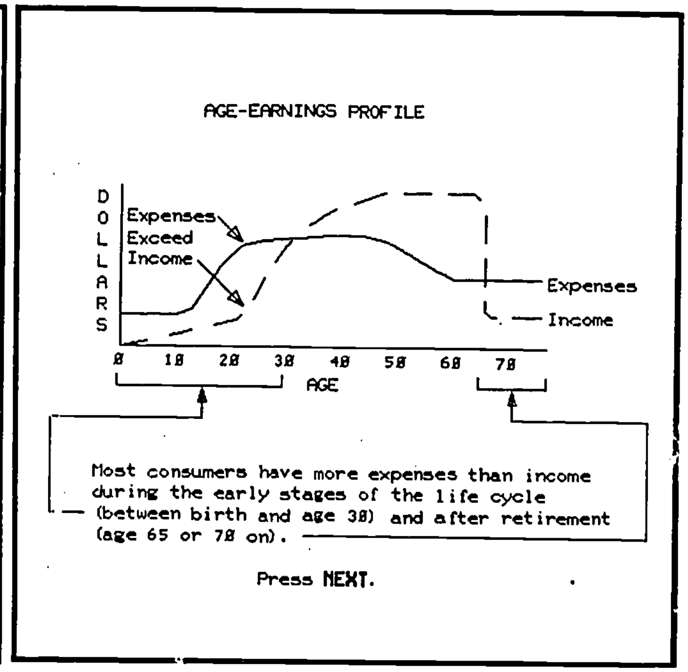


Figure 88. "Consumer in the Marketplace Topic: Transfer of Income," by James Morrison. Copyright© 1986 by the University of Delaware.

"Consumer Financial Management" is a simulation of financial planning in which the student assumes the role of a certified financial planner. The student interviews a client and assists in the development of a personalized financial strategy by applying ten personal finance principles. Student progress is recorded in order to evaluate the financial strategy.

Consumer economics majors in Advanced Financial Management used "Financial Cookbook" on the Apple to consider tax, mortgage, interest rates, IRAs, and other financial variables in evaluating long term implications for financial planning. Figure 89 illustrates one of the "recipes" from "Financial Cookbook." The program allows the student to determine how much money would be left after paying taxes and the early withdrawal penalty if funds were withdrawn from an IRA before reaching the age of 59 1/2. In figure 90, the program calculates how much life insurance is needed in order to provide beneficiaries with replacement buying power for some number of years after the insured's death.

In like manner, students in Consumer Financial Management used faculty-adapted versions of Lotus 1-2-3 on the IBM PC to practice long-range family financial planning; one unique adaptation included figuring in the cost of raising children. Using the computer to do the computations, students in both courses were free to explore a variety of "what if" conditions and implement financial planning decisions accordingly.

Other applications of Lotus 1-2-3 allowed students to set up, monitor, and evaluate personal financial analyses. For Housing students, the program was used to tailor case studies of applications to purchase a house. Figuring in such factors as affordability criteria and comparable mortgage plans was an integral part of the exercise.

```
16 Early Withdrawals from an IRA

FINDS TAX AND PENALTY ON EARLY IRA
WITHDRAWAL

          INITIAL IRA BALANCE $ 19000
               AMOUNT YOU NEED $ 4500
            MARGINAL TAX RATE % 30

AMOUNT YOU MUST WITHDRAW .. $   7500
PENALTY ................... $    750
INCOME TAX ................ $   2250
AMOUNT LEFT TO SPEND ...... $   4500

ENDING IRA BALANCE ........ $ 11500
```

Figure 89. "Financial Cookbook," by Electronic Arts. Copyright© 1984. Used with permission.

```
17 How Much Life Insurance You Need

FINDS LIFE INSURANCE NEEDED TO PROVIDE
STEADY MONTHLY BUYING POWER

     INITIAL MONTHLY INCOME $ 1500
    YEARS TO RECEIVE INCOME   15
        INTEREST RATE EARNED % 7
         COMPOUNDING PERIODS   365
              INFLATION RATE % 2.5
           MARGINAL TAX RATE % 22

INSURANCE NEEDED .......... $213793

TOTAL WITHDRAWN ........... $224702
INTEREST EARNED ........... $126390
TAXES PAID ................ $ 27606

     ------WITHDRAWALS------
YR  MONTHLY  ANNUAL   TAX PD BALANCE
 1  $   1500 $ 18000 $  3280 $207423
 2  $   1538 $ 18450 $  3175 $200232
 3  $   1576 $ 18911 $  3057 $192160
```

Figure 90. "Financial Cookbook," by Electronic Arts. Copyright© 1984. Used with permission.

Students have also benefited from a series of lessons in Architectural Drawing. Figure 91 shows a display from a lesson called "Sketch Lines." Other lessons deal with architectural lettering and dimensioning. Interior design majors apply these lessons to the drawing of floor plans, elevations, section views, and perspectives.

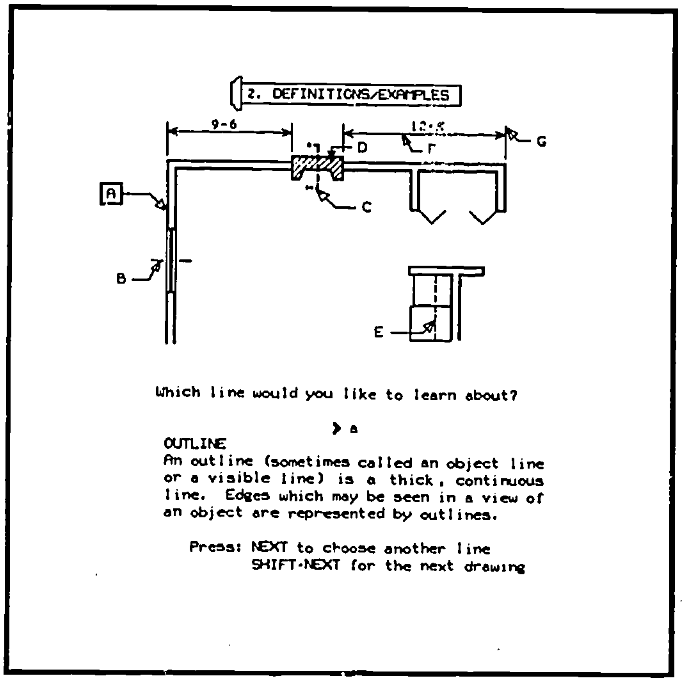


Figure 91. "Sketch Lines," by Louisa Frank; Revised by Laurie Gil and programmed by Wayne Boening. Copyright© 1984 by the University of Delaware.

Languages

The Department of Languages and Literature has developed two kinds of lessons. First, there is a Substitution Drill and an Underliner lesson that can be used for all foreign languages. Each package has its own editor and driver. Second, lessons have been written for specific foreign languages, namely, Latin, Spanish, and French.

Substitution Drill

The "Editor" in the substitution drill package guides teachers through the steps of creating their own curricula of drills. Without a knowledge of programming or the benefit of a programmer, the teacher can insert drills in almost any alphabetic language. Figure 92 shows a drill written by a teacher of ancient Greek. The computer has separated the teacher's sentence into a column of words and indicates what the student should do with the sentence. The third word is underlined to show that the student will be asked to substitute a different word. Boxes are put around words the student should change grammatically as a result of the substitution. In the completed drill the model sentence is shown, with an underlined word and the word (in brackets) that the student should substitute.

Underliner

A general-purpose editor in the Underliner package allows the instructor to enter a foreign-language passage and its English translation. The program guides instructors through the text, allowing them to underline each word or phrase in turn, specify its English equivalent, and append a comment. When the students use the lesson, they may indicate any word by underlining it; the related words of the foreign-language phrase are then highlighted, as is the English translation, and the instructor's comment on that word (if any) is displayed. When ready, the students proceed to a quiz in which words are omitted from the passage at random and must be filled in, as shown in figure 93.

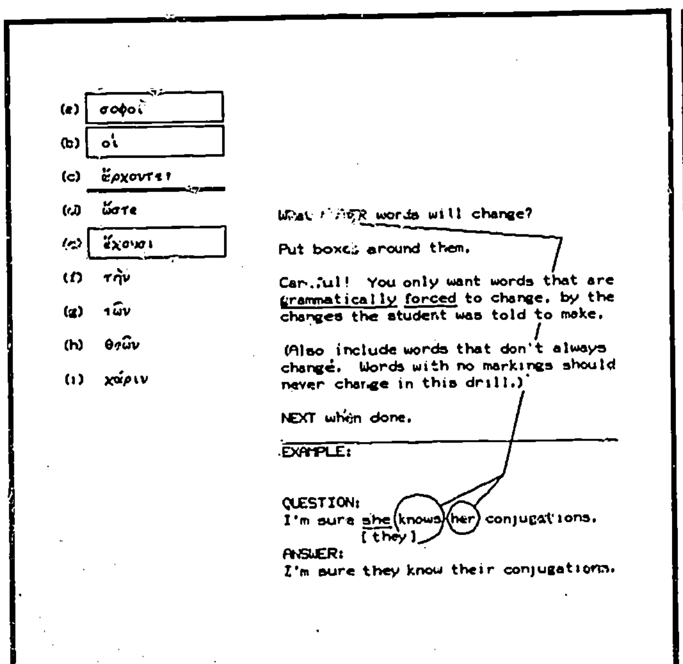


Figure 92. "Substitution Drill Editor," by Dan Williams. Copyright© 1977, 1978, 1979 by the University of Delaware.

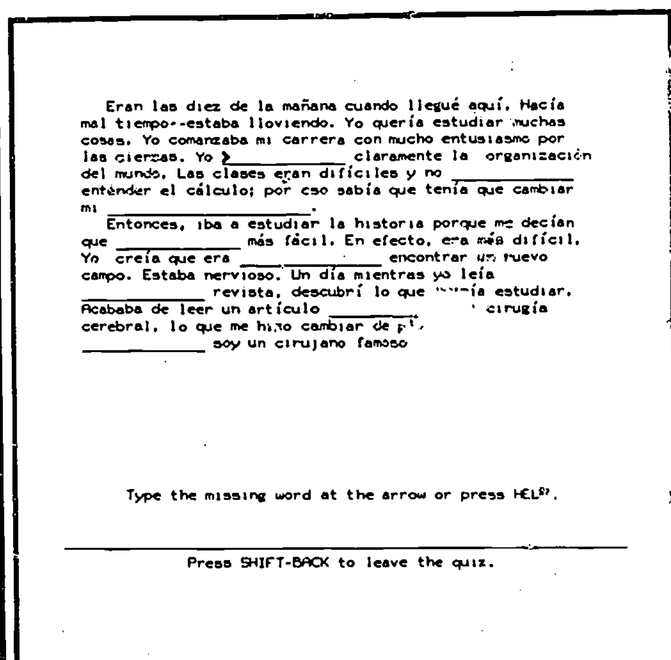


Figure 93. "Underliner," by Thomas A. Lathrop, George W. Mulford, Eileen Kapp, and Craig Prettyman. Copyright© 1986 by the University of Delaware.

Spanish

A thirteen-lesson package has been developed for use with the Spanish text ¡Español! Lengua y cultura de hoy. Each lesson is a drill that deals with up to five areas of grammar. Most lessons end with a quiz. Figure 94, from lesson five, shows a mouse (el raton) behind a chair (la silla). The student must decide where the mouse is in relation to the chair. In this case, the student has typed the correct response, but has forgotten the accent on "esta." The feedback includes help on which key will produce the accent.

French

The French language project develops lessons that emphasize three approaches to the study of language: vocabulary, verbs, and word order. Each approach is discussed in turn as follows.

The first-semester French course has been revised to emphasize vocabulary acquisition, reducing the previous emphasis on grammar. Students must pass PLATO vocabulary lessons in order to complete the course. The lessons rely on the computer's record-keeping ability to inform students of the words they have mastered and which words need more work.

To study the vocabulary, students choose one of three methods. The first method is illustrated in figure 95, where the student correctly identified one of 140 pictures created for this lesson.

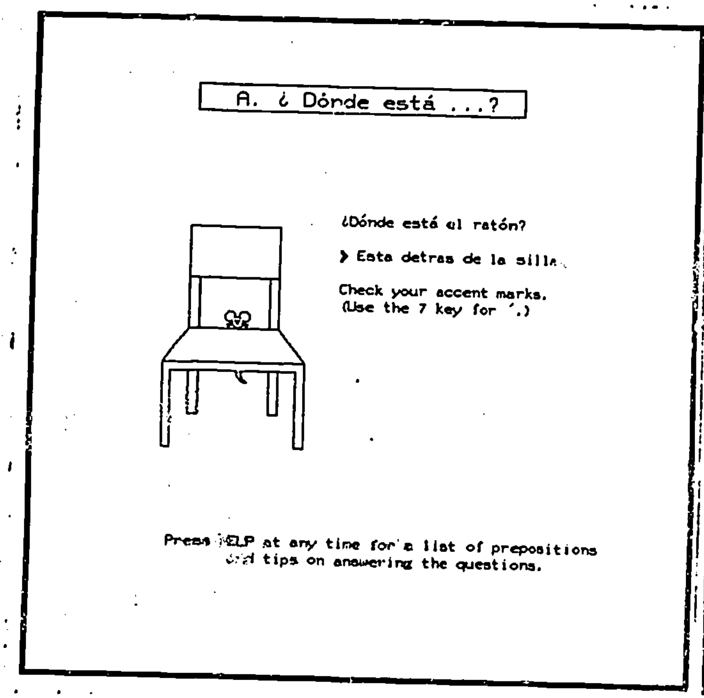


Figure 94. "¡Español! Lengua y culturade hoy 5," by Thomas A. Lathrop, Eileen Kapp, and George W. Mulford. Copyright© 1981 by the University of Delaware.

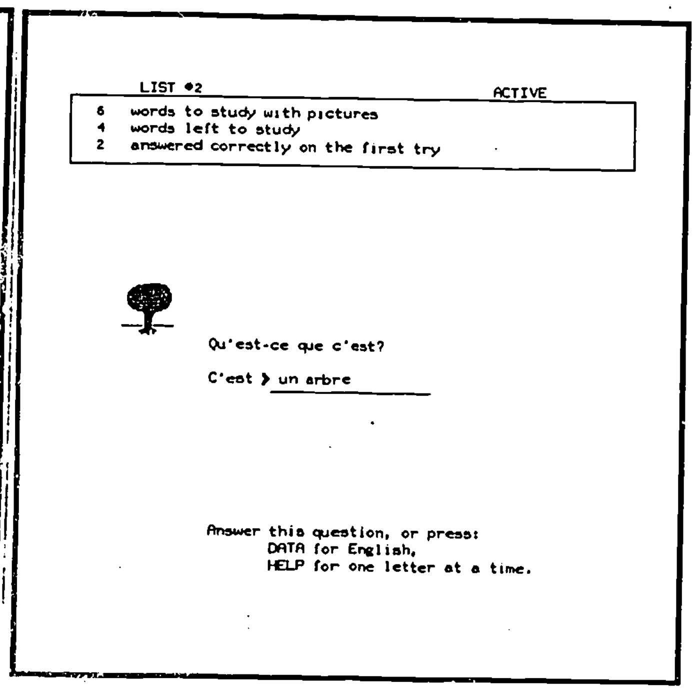


Figure 95. "Les quatre cents Mots: 400 French Words," by T.E.D. Braun, Vickie Gardner, George W. Mulford, Charles Collings, Mark Baum, and K. Jones. Copyright© 1985 by the University of Delaware.

The second method is based on an earlier PLATO lesson written by Professor John P. McLaughlin of the Department of Psychology. The student is asked to arrange words on the screen by touching them. Because Professor McLaughlin's work confirmed earlier research showing that grouping together words of similar meaning is an effective way to remember them, the student is encouraged to arrange the words on the screen so they "make sense." After completing an arrangement, the student must recall the words and type them. Figure 96 shows the exercise almost complete; the blank lines show where the words not yet remembered belong.

In a third method, a French sentence with a missing word is shown to the student. At the same time, a random-access audio device speaks the completed French sentences through a set of headphones. The student must listen to the recording, identify the word, and type it correctly.

A "French Verb" lesson drills students in verb conjugation. The instructor enters up to 300 verbs arranged in up to sixty chapters. Each chapter covers a single tense or contrasts two tenses. Students use the instructor's chapters or make up their own.

Students who do not know the answer have access to several kinds of help. Figure 97 shows the choices available. The choice "rules for forming the present subjunctive" steps the student through the rules and then provides an animated display of the construction of any verb the student chooses. This is made possible by a knowledge base that covers all the rules of derivation of stems and endings. To animate the display, the lesson draws upon these rules, detects any point at which the particular verb is an exception to a rule, and explains both the rule and the exception to the student.

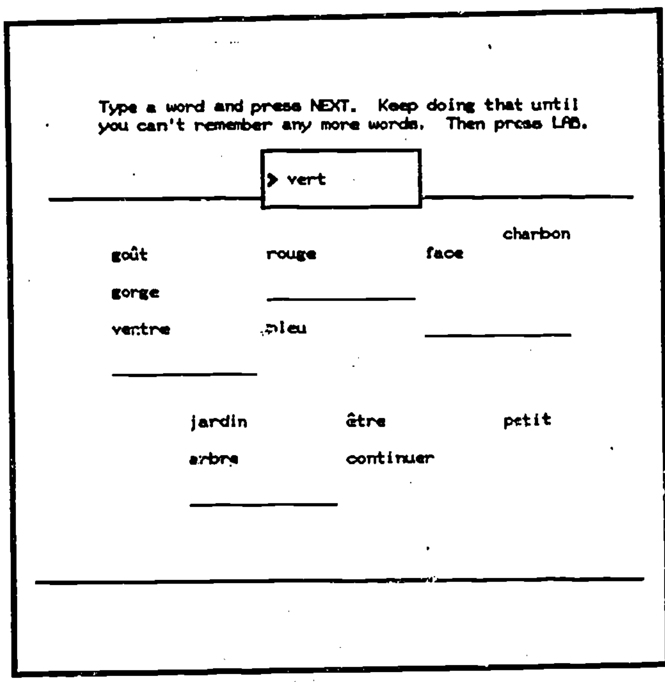


Figure 96. "Les quatre cents Mots: 400 French Words," by T.E.D. Braun, Vickie Gardner, George W. Mulford, Charles Collings, Mark Baum, and K. Jones. Copyright© 1985 by the University of Delaware.

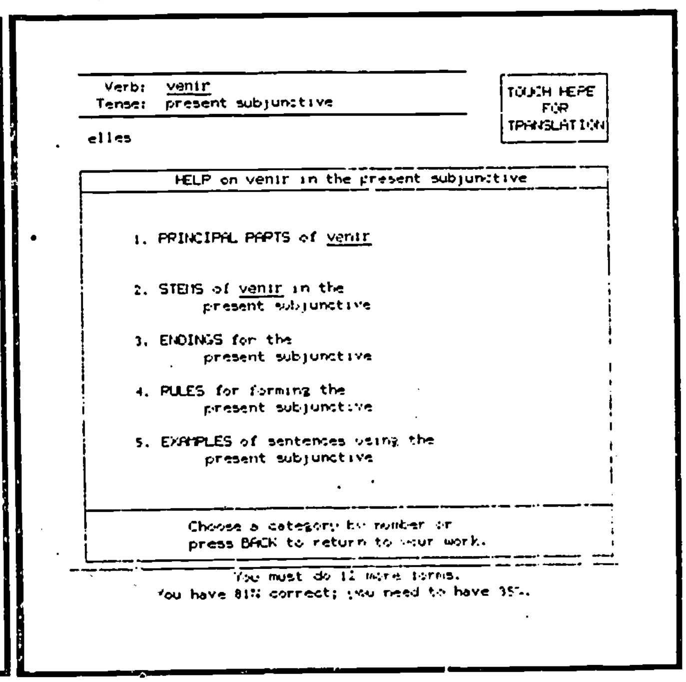


Figure 97. "French Verbs," by T.E.D. Braun, George W. Mulford, Vickie Gardner, and Sharon Correll. Copyright© 1985 by the University of Delaware.

"Touché" is a word-order lesson that uses the touch panel to help students learn French word order. Figure 98 shows how "Touché" presents the student with all of the words of a sentence displayed in a scrambled manner in a vertical column. The student is asked to touch the words on the screen in the proper order, building the correct sentence word-by-word. As the student touches the words, they disappear and then reappear at the top of the screen, as long as the student continues to touch them in the correct order. When the last word has been touched, an English translation appears at the bottom of the screen. If the student makes a mistake by touching a word out of order, the screen goes blank, and the whole sentence reappears in a newly scrambled order. Using this simple procedure it has been possible to design exercises covering many of the difficulties encountered in the first two years of French. To correctly complete the sentences, the students must recognize parts of speech, verb agreements, different types of object structure, and the grammatical function of each noun or pronoun. An explanatory display preceding each exercise points out the rules governing the particular word order problem being drilled; the student can recall that display along with the completed correct sentence and its English translation at any time by touching the HELP box.

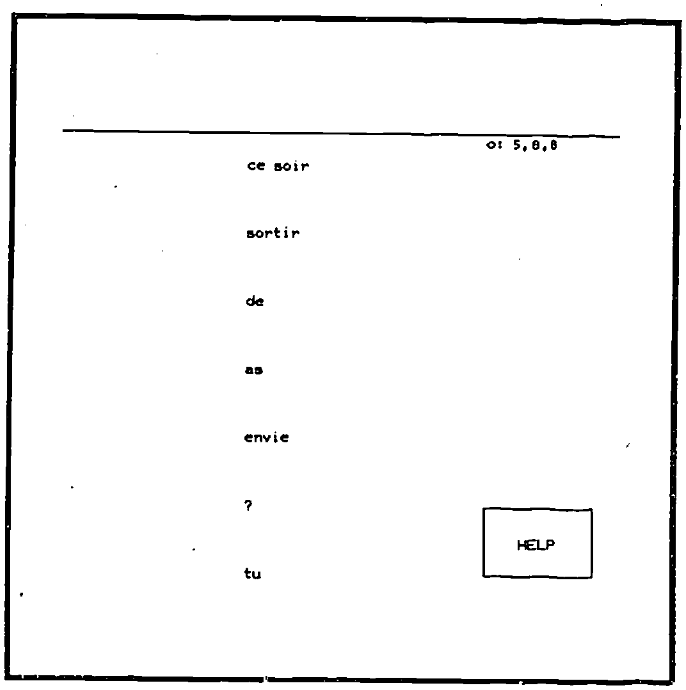


Figure 98. "Touché: A French Word Order Touch Lesson," by George W. Mulford and Dan Williams. Copyright© 1981 by the University of Delaware.

Latin

Of the six-lesson Latin curriculum developed for PLATO from 1977 to 1986, five programs have been converted to run on Apple II+, Apple IIe, IBM PC with Quadlink board, Franklin, and Bell & Howell microcomputers.

Routines written for the PLATO system enable all five Latin lessons to inflect the variable parts of speech. This technique permits flexibility of responses to student errors because the lessons "understand" the structure of Latin forms. Figure 99 shows a display from "The Verb Factory." The student tried to write the Latin translation of the phrase "you (singular) are well." The typed form "valetis" was judged correct in stem and tense/mood sign, but wrong in its personal ending. Whenever students have severe difficulty in getting the right answers, the lesson takes them through a checklist of grammatical components to help isolate any problems, and the "Verb Factory" manufactures the correct verb form, one part at a time. This diagnostic lesson is paired with a verb-form game, "Cursus Honorum," which builds skill in producing and parsing verb forms. The content and skill level are set by the student, a feature that permits continued use of the lesson throughout the year.

A third lesson, "Mare Nostrum," applies features analogous to those in the verb lessons to noun-adjective phrases, and a fourth lesson, "Translat," handles sentence translation. For any word from the 180 sentences in the "Translat" data base, the student may interrogate the computer to learn the dictionary entry, the English meaning, the grammatical form, or the word's function in context. Thus freed from the task of juggling dictionary and grammar books, the student concentrates on the translation process itself.

In figure 100 from the fifth lesson, "Artifex Verborum," the student practices analyzing the words in Latin sentences. After correctly parsing the first six words

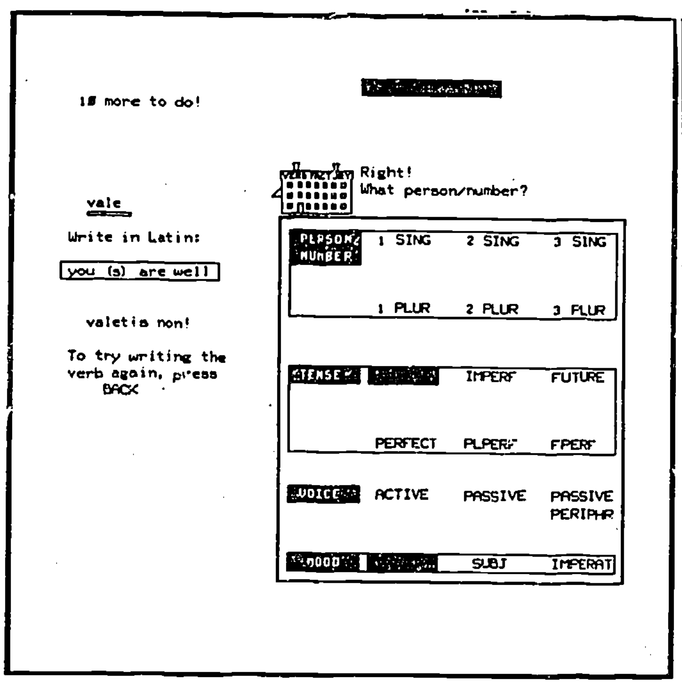


Figure 99. "The Verb Factory," by Gerald R. Culley. Copyright© 1978, 1980 by the University of Delaware.

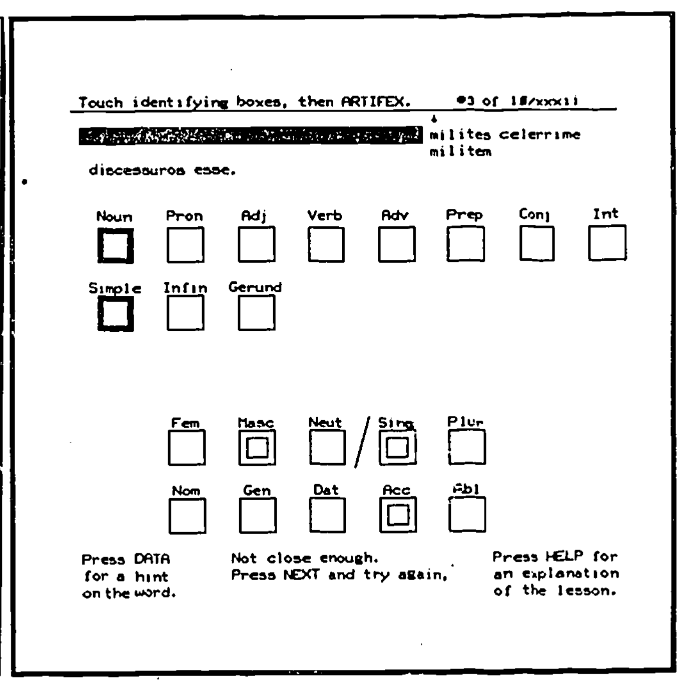


Figure 100. "Artifex Verborum: An Exercise in Latin Sentence Analysis," by Gerald R. Culley. Copyright© 1980 by the University of Delaware.

in this sentence, the student encounters "milites" and identifies it correctly as a simple noun, but then touches boxes to mark it as masculine singular accusative, which is incorrect. The lesson illustrates the error by computing and then displaying the masculine singular accusative of the word below the form the student is analyzing. All of the lessons in the Latin series can be edited by an instructor without programming knowledge.

Developers found it necessary to program two utilities to aid in the conversion of the PLATO materials to the Apple. The first utility allows the programmer to recreate the original PLATO display within the specifications of the Apple screen as shown in figure 101. The second utility provides the programmer with the capability of translating TUTOR into BASIC code, as demonstrated in figure 102. These utilities have saved approximately one-third of the time needed for lesson conversion.

The Apple versions of the Latin lessons use a specially designed light-pen to simulate PLATO's touch capability. The light-pen is accurate, quick, and frees the user from complicated keyboard input. In the winter of 1985, students used the Latin Skills Package on the OCBI Apple network. Further information about Latin Skills is contained in the Publication and Products section of this report.

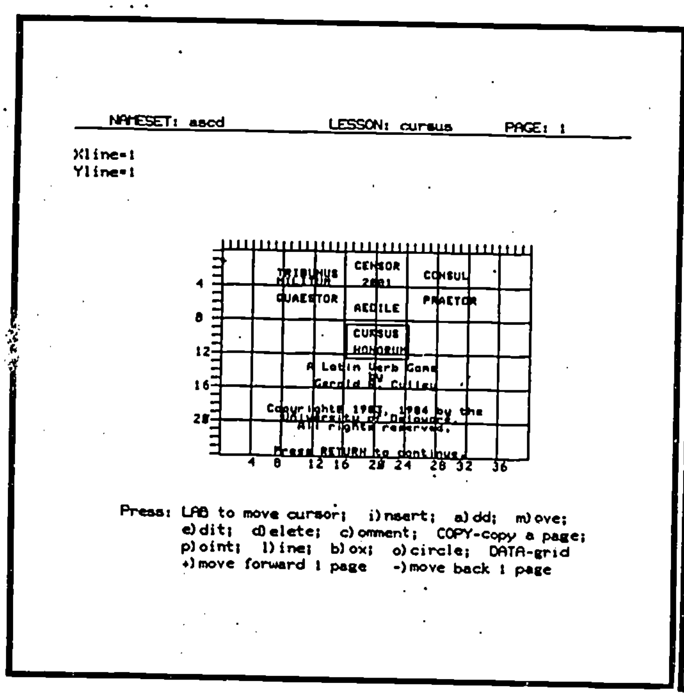


Figure 101. "Micro Script Converter," by Louisa Frank. Copyright© 1983, 1984 by the University of Delaware.

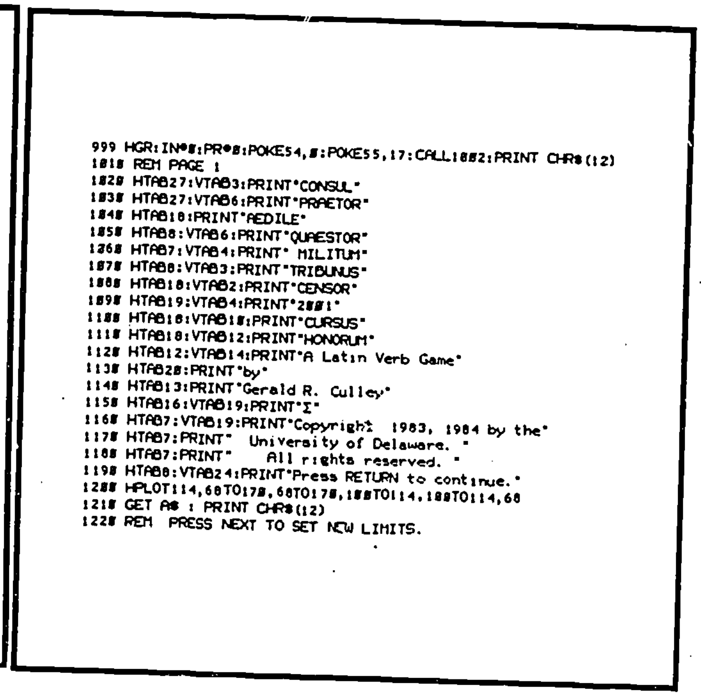


Figure 102. "Micro Code Converter," by Graham Oberem and Louisa Frank. Copyright© 1983, 1984 by the University of Delaware.

The most recent PLATO lesson, "Lector," is a tool for analyzing Latin sentences. Students choose a topic such as "nouns," "pluperfect tense," "appositives," or "indirect questions" for study. The lesson presents questions from a data base of 400 sentences and asks the student to identify parts of speech. In figure 103, the student has wrongly identified "oratorem" as a direct object. The lesson knows the syntax of each word in the data base and explains the error.

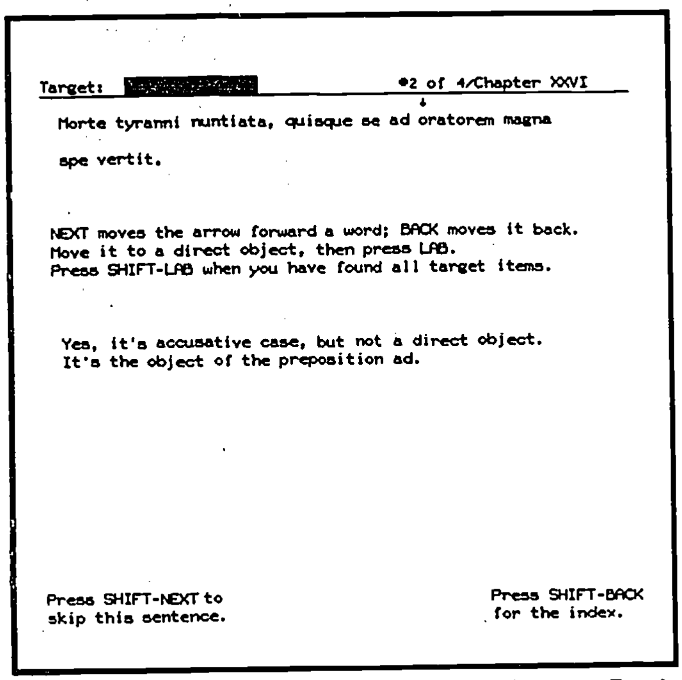


Figure 103. "Lector: A Tool for Latin Sentence Analysis," by Gerald R. Culley. Copyright©1985 by the University of Delaware.

Library

The library has developed a package of five PLATO lessons that teach basic library research skills to University of Delaware students taking freshman English. The lessons replace lectures that were previously given by reference librarians. Each lesson consists of a tutorial with built-in drill and practice. A forty-question multiple choice test covers the content of all five tutorials.

The first lesson, "Card Catalog," explains how the card catalog is used to locate books by author, title, or subject. This lesson also discusses the use of the Library of Congress Subject Headings in determining appropriate subject headings to be used in the card catalog. Figure 104 shows a summary of the search strategy for locating books in the library.

The second lesson, "Periodical Indexes," discusses periodical articles as a source of information and teaches the use of various periodical indexes to find articles on specific topics. This lesson also introduces the student to the University of Delaware Library's serial records catalog. Figure 105 shows part of an explanation of the contents of a holdings card; the student is shown how to interpret the information on the card in order to locate the periodical in the library.

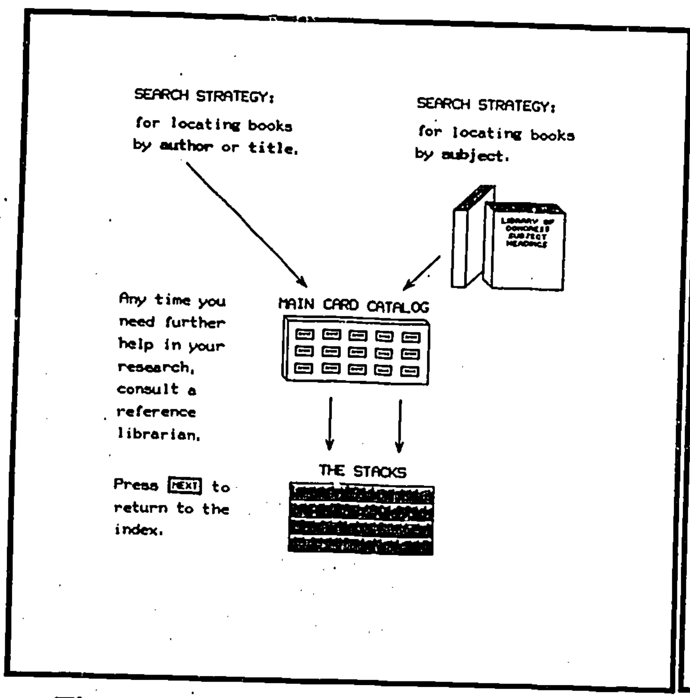


Figure 104. "Card Catalog," by Patricia Arnott, Patricia FitzGerald, Lynne Masters, Jeffrey Snyder, Cynthia Parker, and Deborah E. Richards. Copyright©1981, 1982, 1983 by the University of Delaware.

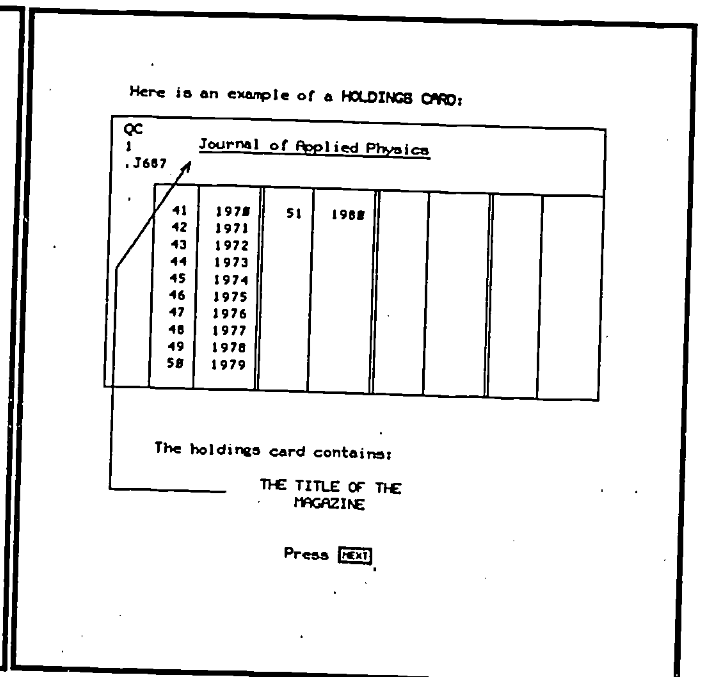


Figure 105. "Periodical Indexes," by Patricia Arnott, Patricia FitzGerald, Lynne Masters, Dawn Mosby, Cynthia Parker, and Deborah E. Richards. Copyright© 1981, 1982, 1983 by the University of Delaware.

The third lesson, "Newspaper Indexes," discusses newspapers as a source of information and explains the use of newspaper indexes. An example of a drill on the parts of a citation found in a newspaper index is shown in figure 106. The student has misinterpreted the abbreviation for the length of the article as part of the date; appropriate feedback is given, and the student is asked to fix the incorrect response.

The fourth lesson, "Government Documents," discusses the types of information published by the U.S. Government and explains how to locate this information by using government documents indexes. Figure 107 shows a drill on the parts of a citation taken from the Monthly Catalog of United States Government Publications. The student must identify an element by typing the number of the arrow that points to it. If the student makes three incorrect attempts, the arrow of the correct response will flash on and off.

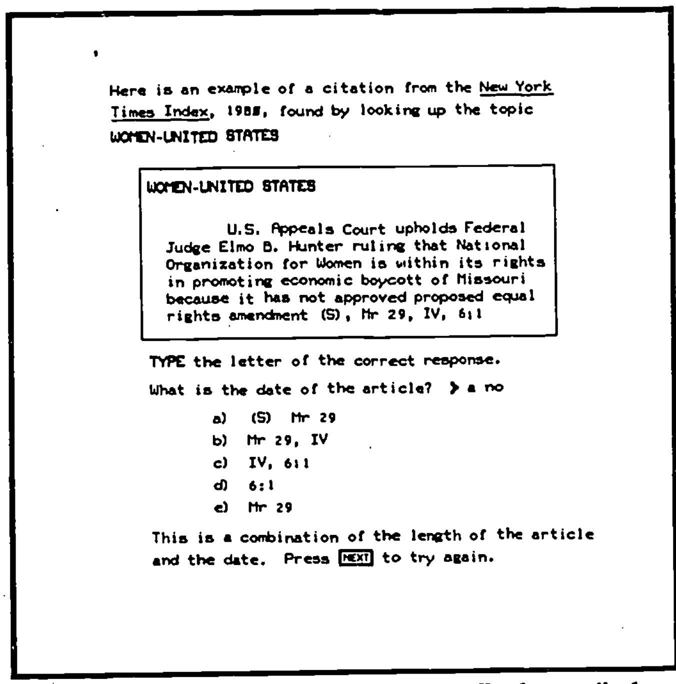


Figure 106. "Newspaper Indexes," by Patricia Arnott, Patricia FitzGerald, Lynne Masters, Amy Sundermier, Jeffrey Snyder, and Deborah E. Richards. Copyright© 1981, 1982, 1983 by the University of Delaware.

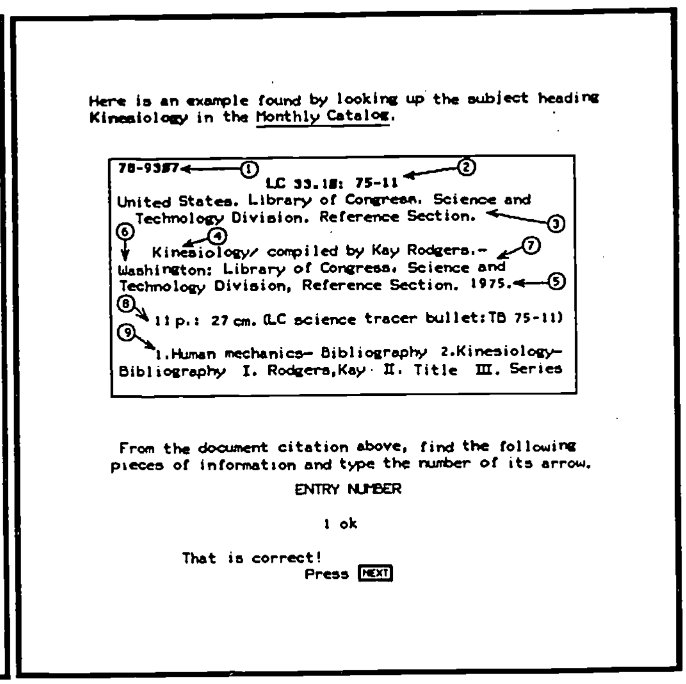


Figure 107. "Government Documents," by Patricia Arnott, Patricia FitzGerald, Lynne Masters, Ivo Dominguez, Jr., and Deborah E. Richards. Copyright© 1981, 1982, 1983 by the University of Delaware.

The library has converted "Periodical Indexes," "Newspaper Indexes," "Government Documents Indexes," and "The Card Catalog" to run on the IBM PC. Items specific to the University of Delaware Library have been removed so the lessons are applicable to virtually all college and university libraries.

The fifth lesson, "Locating Library References," is specific to the University of Delaware Library. It gives information on the physical location of books, periodicals, newspapers, and government documents. Each section of the lesson guides the student through a step-by-step process for locating these materials in the library. The final step in finding books in the library is illustrated in figure 108.

The forty-question multiple choice test includes information from all five tutorials. The student answers the questions by touching or typing the letter of the correct response.

Four PLATO lessons have been developed to teach upperclassmen how to use the citation indexes. The first lesson, "Using the Citation Indexes," explains the concept of citation indexing and some of the features common to all citation indexes. Figure 109 shows an explanation of the parts of an entry in the Source Index.

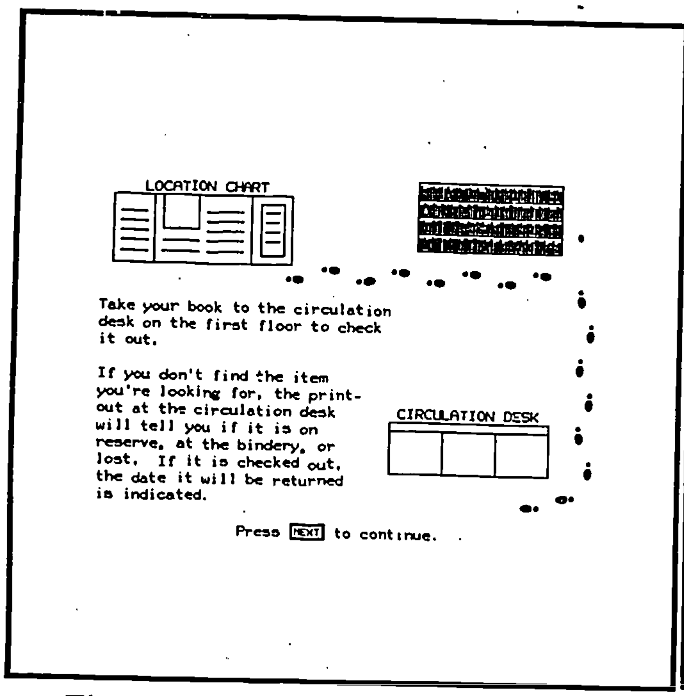


Figure 108. "Locating Library References," by Patricia Arnott, Patricia FitzGerald, Lynne Masters, Mark Baum, and Cynthia Parker. Copyright© 1981, 1982 by the University of Delaware.

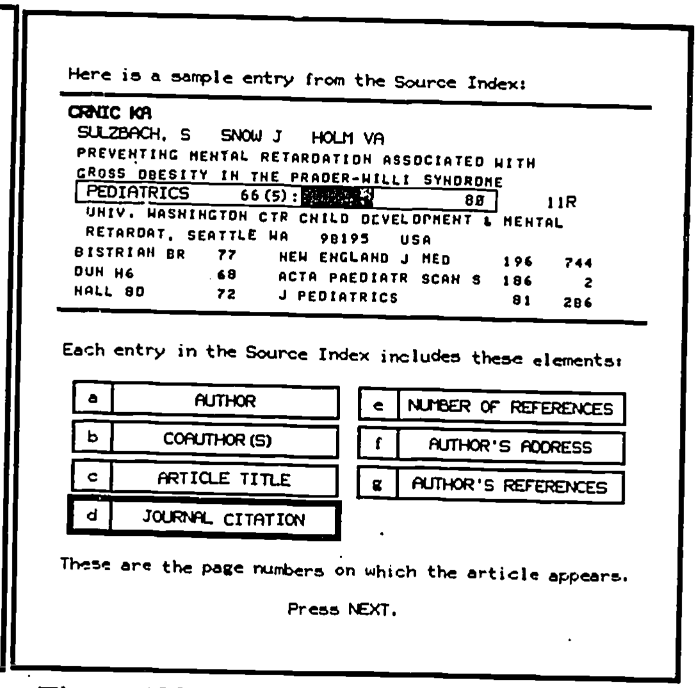


Figure 109. "Using the Citation Indexes," by Patricia Arnott, Margaret G. Bronner, Jack W. Levine, Jack O'Gorman, Deborah E. Richards, and Patrick J. Mattera. Copyright© 1985 by the University of Delaware.

The second lesson, "Using the Science Citation Index," describes the organization and content of the Science Citation Index®. Several strategies are presented for using the index to find articles in a science-related subject area. Figure 110 shows an explanation of the Permuterm Subject Index.

The third lesson, "Using the Social Sciences Citation Index," presents strategies for using the index to find articles in the social sciences. An explanation of the three major sections of the Social Sciences Citation Index® is illustrated in figure 111.

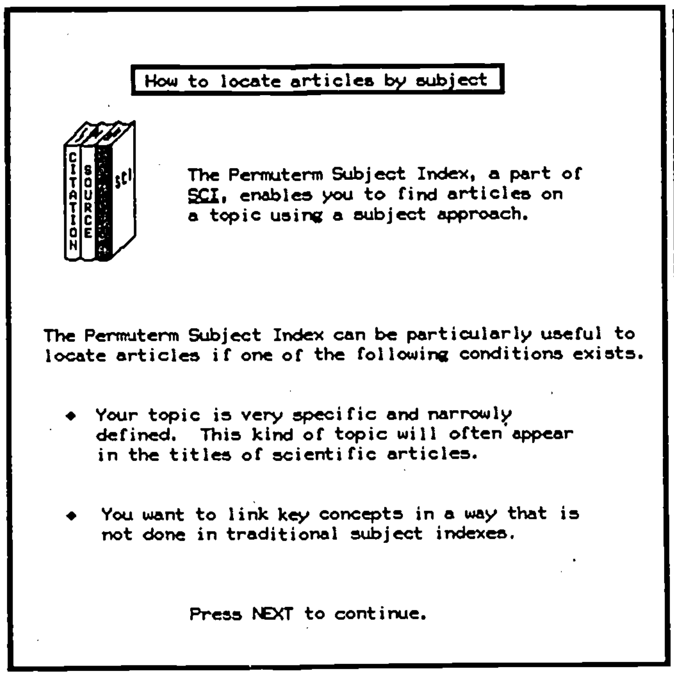


Figure 110. "Using the Science Citation Index," by Patricia Arnott, Margaret G. Bronner, Jack W. Levine, Jack O'Gorman, Deborah E. Richards, and Dorothy Colburn. Copyright© 1985 by the University of Delaware.

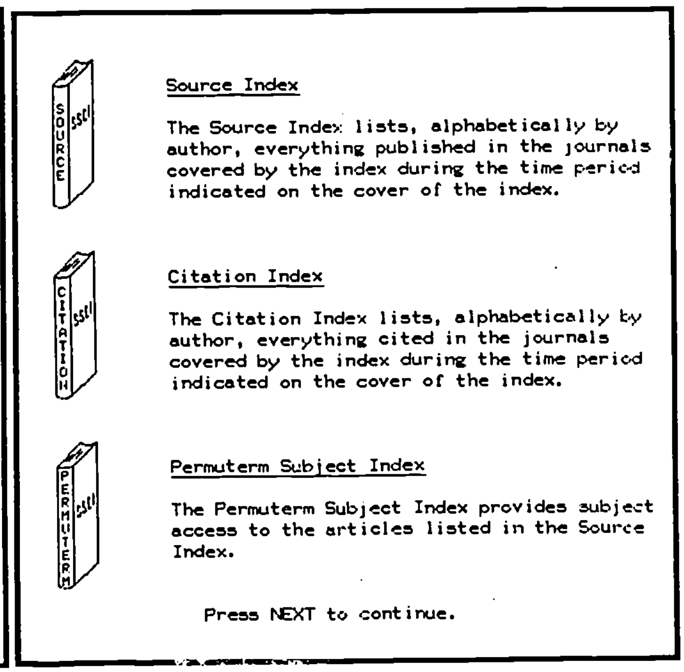


Figure 111. "Using the Social Sciences Citation Index," by Patricia Arnott, Margaret G. Bronner, Jack W. Levine, Jack O'Gorman, Deborah E. Richards, and Dorothy Colburn. Copyright© 1985 by the University of Delaware.

Science Citation Index® and Social Sciences Citation Index® are the registered trademarks of ISI Institute for Scientific Information.

The fourth lesson, "Using the Arts & Humanitics Citation Index," explains how to find poems, short stories, music scores, or articles. Figure 112 illustrates a unique feature of the <u>Arts & Humanities Citation Index</u>™, which treats artistic works as cited references.

Here is an example from the 1982 Citation Index.

TURNER JMW
LAKE OF GENEVA WITH ↑ ILL 1803
BAYARD J PORTFOLIO 4 66 82

In the example above, you can see that J.M.W. Turner's painting "Lake of Geneva with Mont Blanc" (1803) is treated is if it were a cited reference in J. Bayard's article in <u>Portfolio</u> in 1982. So, <u>AHCI</u> has added Turner to the Citation Index.

In fact, Bayard did not formally cite Turner or this painting in the bibliography. <u>AHCI</u> uses the "↑" symbol to indicate that it is listing Turner as if he were a cited author.

The symbol "ILL" indicates that the work of art is reproduced in the article.

Press NEXT to continue.

Figure 112. "Using the Arts & HumanitiesCitation Index," by Patricia Arnott, Margaret G. Bronner, Jack W. Levine, Jack O'Gorman, Deborah E. Richards, and Dorothy Colburn. Copyright© 1985 by the University of Delaware.

<u>Arts & Humanities Citation Index</u>™ is the trademark of ISI Institute for Scientific Information.

Life and Health Sciences

The School of Life and Health Sciences uses PLATO lessons to supplement laboratory exercises in genetics. Genetics exercises traditionally require students to learn time-consuming and mechanically difficult procedures. In an actual laboratory situation, students often overlook the important concepts under study in their efforts to complete complicated manual procedures within the time allotted. The flexible, interactive nature of the PLATO genetics lessons permits students to design experiments, obtain data, graph and analyze results, and draw conclusions without first having to master expensive and time-consuming procedures that do not contribute to an understanding of the concepts. Using a PLATO lesson as a tool, students unskilled in laboratory procedures can obtain data from sources that are normally not available to them.

Professor David E. Sheppard received a Local Course Improvement grant from the National Science Foundation to develop a complete genetics curriculum. Four lessons have been programmed and student tested, namely, "Somatic Cell Structures," "Positioning Genes in Bacteria by Deletion Mapping," "Recombinant DNA: Techniques and Applications," and "The Molecular Basis of Mutation." Five lessons are now under development, namely, "Crossing Over in Drosophilia," "The Histidine Operon," and a series of three lessons called "The lac Operon in E. coli."

Figure 113 shows a display from the lesson "Somatic Cell Genetics." In a simulated experiment, students learn techniques used to locate genes on chromosomes.

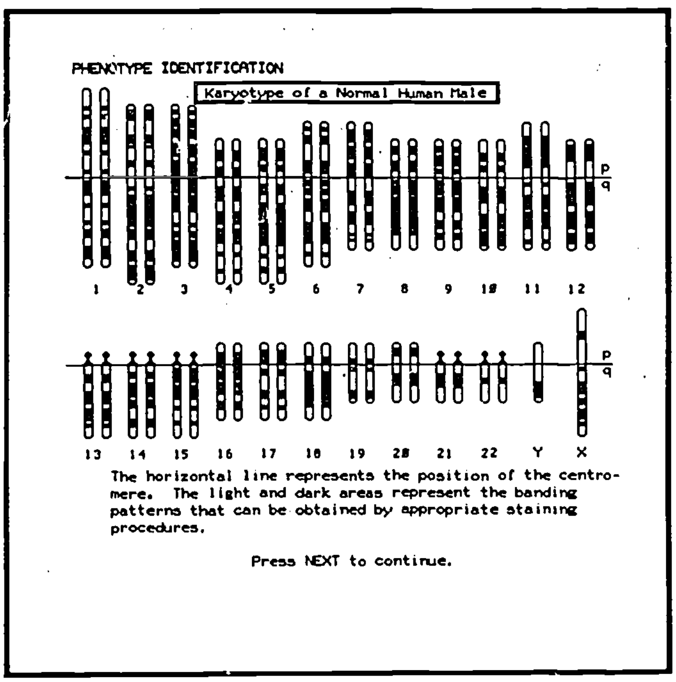


Figure 113. "Somatic Cell Genetics," by David E. Sheppard. Copyright© 1984 by the University of Delaware.

Students must isolate cells that exhibit an abnormal trait and then determine which genes govern this trait and on which chromosome they are located. First, the students simulate the growth of cells on various culture media. Then, by correlating the absence or presence of the trait with the presence of a certain chromosome, students can eventually pinpoint the exact location of the controlling gene.

Figure 114 shows a genetic map from the deletion mapping lesson. Students are presented with a matrix of deletion mutation crosses and are asked to determine which deletion mutations overlap and what are the relative orders of the deletions on the genetic map. With the aid of interactive instructions, students are able to complete a difficult laboratory exercise much more easily than in a conventional laboratory situation. Upon completion of the exercise, student work is evaluated immediately. Students receive informative feedback to point out incorrect positioning, and they are asked to make changes to obtain a correct mapping.

Figure 114, from "Recombinant DNA: Techniques and Applications," shows how the plasmid DNA of E. coli can be introduced into other E. coli cells. Plasmids often exhibit resistance to antibiotics (in this case, to tetracycline). When plasmids are placed in other cells of the same species, the other cells also gain the ability to tolerate the growth of antibiotics. Growing these cells in the presence of tetracycline inhibits the growth of cells that do not contain the plasmid. In this way one can select for cells that have undergone transformation and now contain the plasmid. Using the PLATO system, students can observe all of the steps involved in this process of transformation.

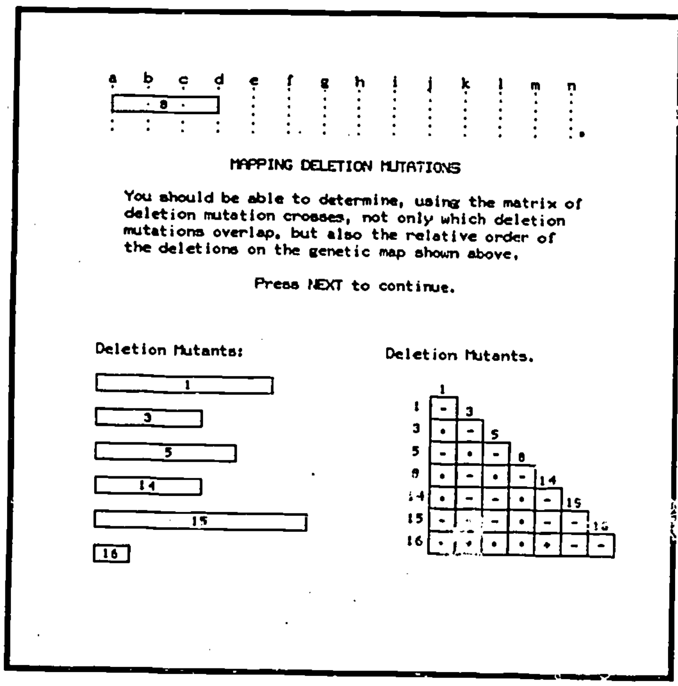


Figure 114. "Positioning of Genes in Bacteria by Deletion Mapping," by David E. Sheppard. Copyright© 1984 by the University of Delaware.

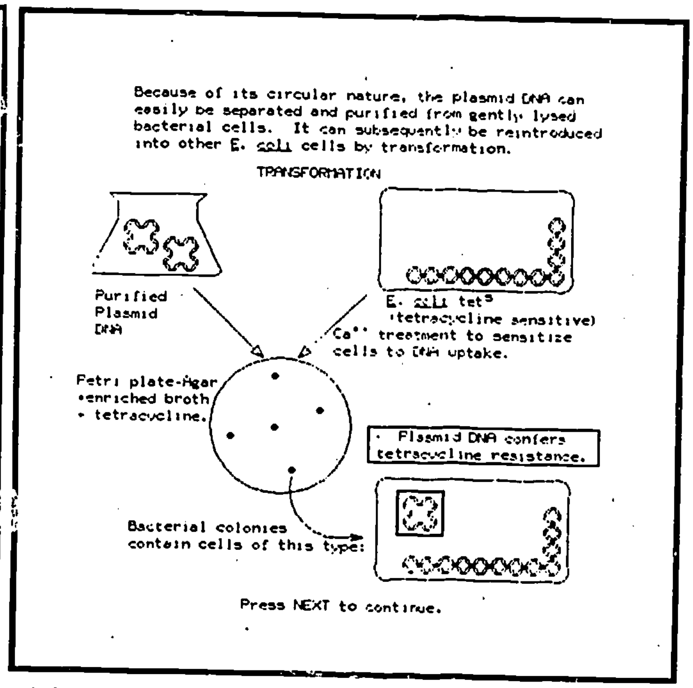


Figure 115. "Recombinant DNA: Techniques and Applications," by David E. Sheppard. Copyright© 1984 by the University of Delaware.

Mathematics

Beginning in the academic year 1977-78 with modest student use of lessons published by the University of Illinois, the mathematics project has grown steadily in numbers of students served, faculty involved, and programs developed. This growth reflects the University's desire to enhance student performance in mathematics courses. A critical milestone for the project was the formation of the Mathematical Sciences Teaching and Learning Center in the spring of 198[illegible]. The purpose of the Math Center is threefold:

1. Improvement of student success in lower division mathematics courses
2. Involvement of pre-service and in-service teachers and mathematics educators throughout the state in improving the quality of mathematics instruction
3. Stimulation of research into relevant facets of mathematics teaching and learning

The Math Center uses a variety of materials and strategies, but it is particularly oriented toward computer-based approaches. It houses a CBI classroom with nineteen PLATO terminals that play a major role in delivering of instruction and conducting research. The Center is also keenly interested in evaluating and developing microcomputer-based mathematics courseware. Microcomputers are located in the Center for this purpose.

A versatile drill package called the "Mathematics Interactive Problem Package" (MIPP) presents a variety of problems to students enrolled in lower-division mathematics courses. Over one thousand problems are available through MIPP in the following two modes:

1. Mixed List Mode. Students may choose sections from the course text and work through randomly selected problems related to those sections. Solution steps are immediately available in this mode.

2. Test Mode. Students may take a complete test under timed test conditions. Solution steps are available upon test completion.

In figure 116, a student has chosen the problem to find cos($-\pi$). The indicated response choice "d" has been marked incorrect. The student may touch the screen or press the DATA key to see the solution to the problem in steps, as shown in figure 117. The student may go through all of the steps of the solution, the last of which gives the correct answer, or may return to the main problem display and select a new response.

An experiment that compared Math 115 students using MIPP on the PLATO system to those receiving only traditional instruction showed that although the mathematical background of the students in the sections using PLATO was weaker than that of those in the traditional sections, more students from the PLATO sections passed the course. There were significantly fewer failures in the PLATO sections. The course drop rate was higher, indicting that MIPP helped some students determine that their backgrounds were inadequate for the course. In addition, student attitudes toward the use of the PLATO system are extremely positive.

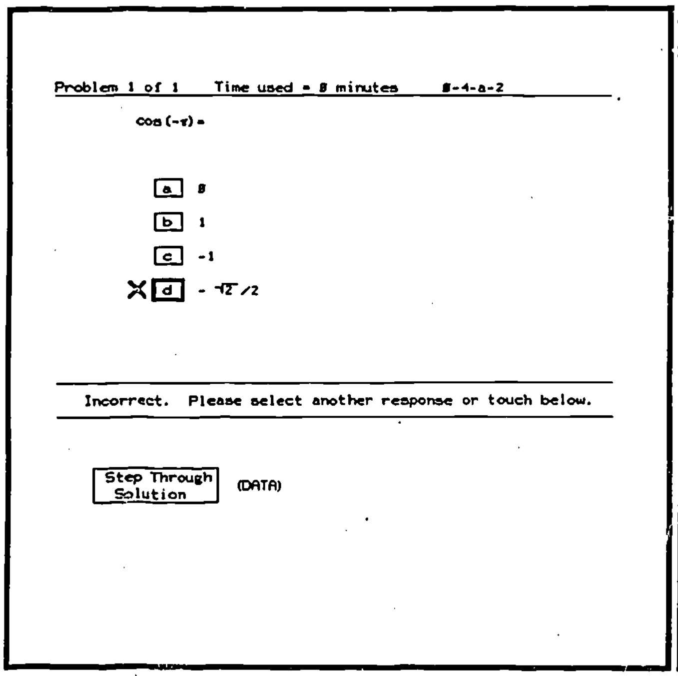


Figure 116. "Mathematics Interactive Problem Package," by Ronald H. Wenger, Morris W. Brooks, Keith Slaughter, and Richard Payne. Copyright© 1978, 1979, 1980, 1981, 1982 by the University of Delaware.

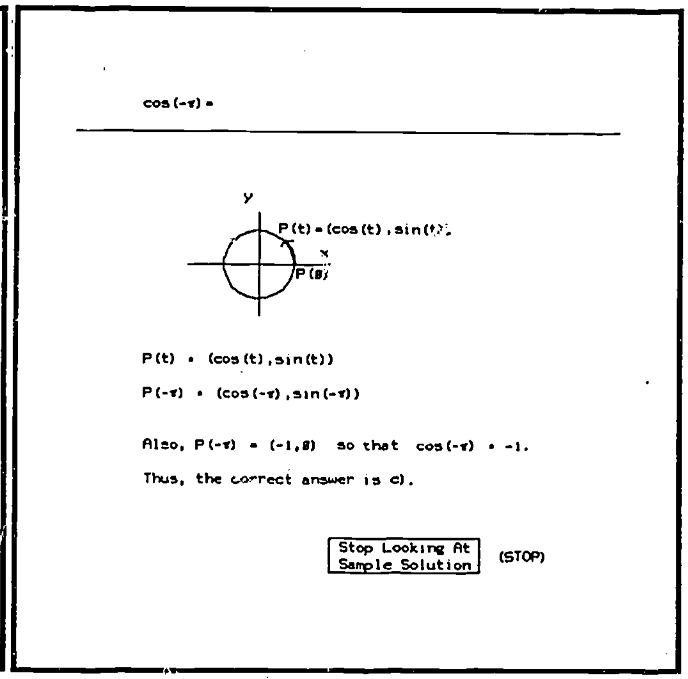


Figure 117. "Mathematics Interactive Problem Package," by Ronald H. Wenger, Morris W. Brooks, Keith Slaughter, and Richard Payne. Copyright© 1978, 1979, 1980, 1981, 1982 by the University of Delaware.

Figure 118 illustrates a problem in which students are asked to find the negative of an algebraic expression that contains parentheses. Research has shown that responses to this type of problem often reveal faulty understanding of the rules of algebra. The student has erred by changing all of the signs in the problem. Figure 119 shows how the PLATO system recognizes this error pattern and gives the student an appropriate diagnostic message.

Thirteen modules of PLATO Learning Management support the intermediate algebra course Math 010. Designed to help students proceed through the course at their own pace, these modules provide diagnostic testing and study prescription.

In 1983, development began on a series of tools for mathematics problem solving. The series includes utilities for plotting mathematical functions, solving systems of linear equations, finding the best-fitting curve to a set of data points, and solving linear programming problems. The tools are being programmed for the IBM PC in the C programming language. They are based on powerful numerical algorithms but are designed to be used easily by students with little computing experience.

In 1984, a conversion of MIPP to the IBM PC was begun. In its microcomputer version, MIPP will offer additional forms of questioning, response-contingent feedback, enhanced answer-judging features, and greater diagnostic flexibility.

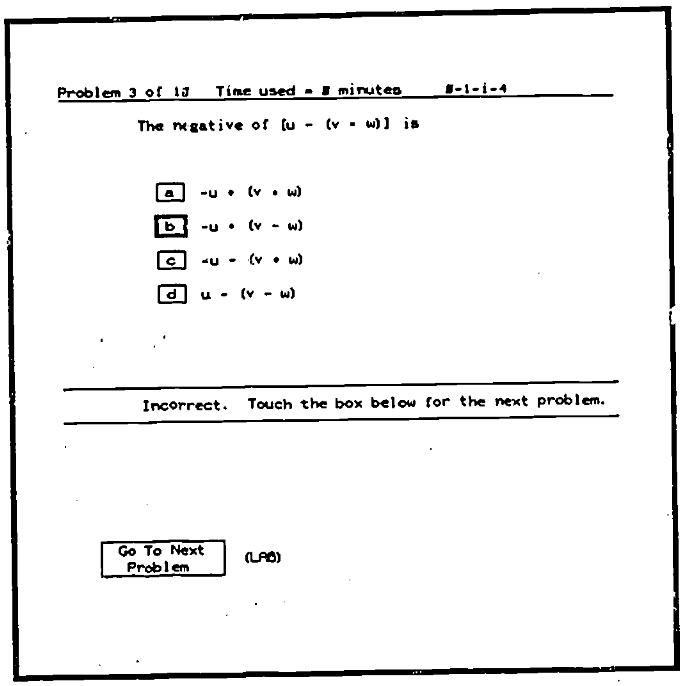


Figure 118. "Module I - Diagnostic Test I," by Ronald H. Wenger, Morris W. Brooks, and Richard Payne. Copyright© 1982 by the University of Delaware.

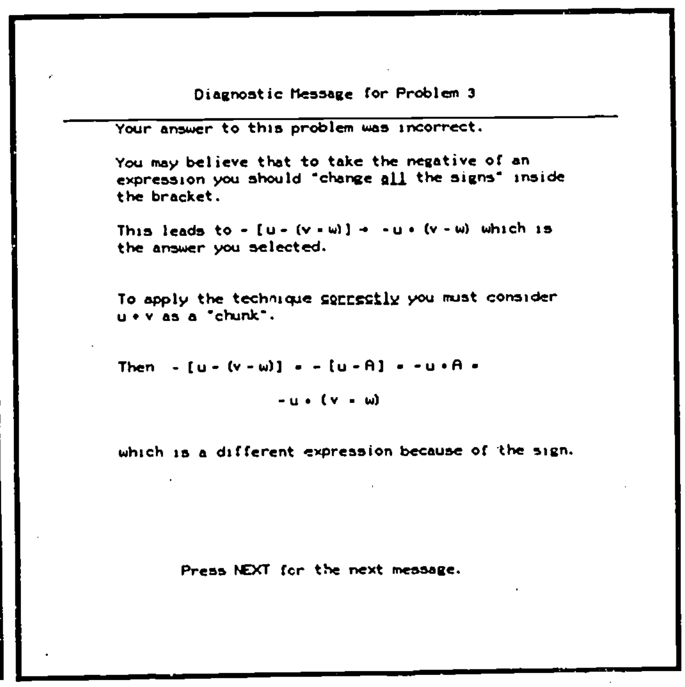


Figure 119. "Module I - Diagnostic Test I," by Ronald H. Wenger, Morris W. Brooks, and Richard Payne. Copyright© 1982 by the University of Delaware.

The program "One-Variable Function Plotter" is designed to provide students with an environment to explore the relationships between algebraic and geometric representations of functions. In figure 120, a student is using the program to solve the equation $x2 - 8 = 2x + 7$ graphically by plotting the functions $A(x) = x2 - 8$ and $B(x) = 2x + 7$. A cursor has been used to locate the point (5,17) where the graphs intersect. Students who understand the relationship between equations and the graphs of the expressions for their left-hand and right-hand sides will know that $x=5$ is one solution to the equation.

The Math Center has received two grants from the National Science Foundation. One allowed the Center to conduct a Leadership Training Program on the Uses of Microcomputers in the Mathematics and Science Curriculum. Twenty-four Delaware teachers with classroom computer experience were appointed Fellows in the Math Center and attended a series of nine monthly workshops and a summer institute. The workshops were conducted by University faculty from the Departments of Mathematical Sciences, Chemistry, and Physics. The goal of the program was to prepare the teachers for conducting in-service training sessions for other teachers in their respective counties and local districts on the uses of computers in mathematics and science education.

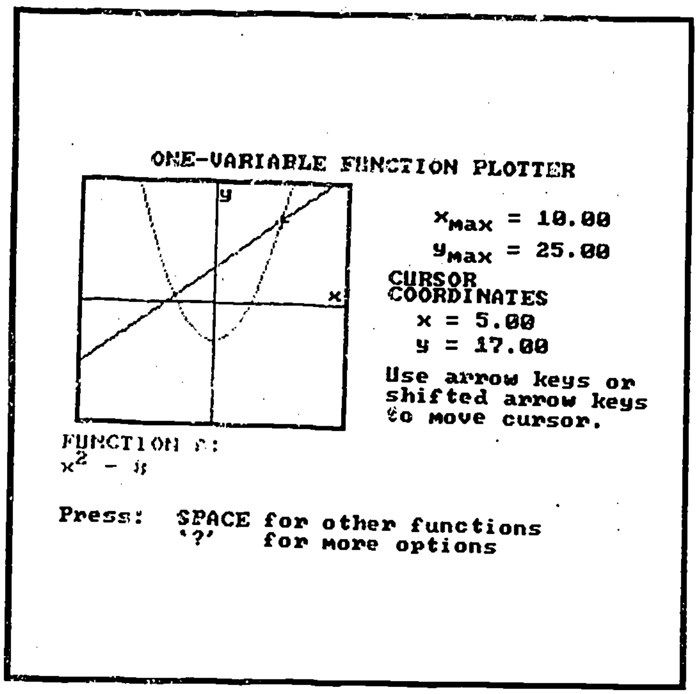


Figure 120. "One-Variable Function Plotter," by Morris W. Brooks and Richard K. Payne. Copyright© 1985 by the University of Delaware.

The second grant, under NSF's Comprchensive Assistance to Undergraduate Science Education (CAUSE) Program, was a three-year $24?,??? award that supported the Math Center's efforts to improve mathematics instruction at the University. The main components of the CAUSE project were as follows:

1. Development of a computer-based diagnostic test to provide a detailed profile of a student's conceptual and algorithmic strengths and weaknesses

2. Revision and extension of the MIPP program to incorporate features of intelligent CAI systems, especially the formation of a student model that will be used to provide individualized tutorial instruction

3. Development of a package of CBI lessons using mathematical models in economics and social science with the goal of improving student attitudes toward mathematics and motivating students to study mathematics

4. Development of University courses dealing with the role of computers in mathematics education for pre-service teachers of mathematics

5. Expansion of the microcomputer facility in the Math Center

In addition to the grants received by the Math Center, two other mathematics development grants have been awarded. Dr. John Bergman received an Improvement of Instruction Grant for the summer of 1981 to develop computer-based learning materials for the special section of Calculus B, Math 242, which is taught for incoming freshman who have already taken a calculus course in high school. Among these materials is a PLATO lesson designed to help students understand the concept of the center of mass of a plane region and the application of the definite integral to computing centers of mass. In figure 121, the student is being shown how the center of mass of a region with a curved boundary may be approximated by the union of four rectangular regions for which the center of mass is easily calculated.

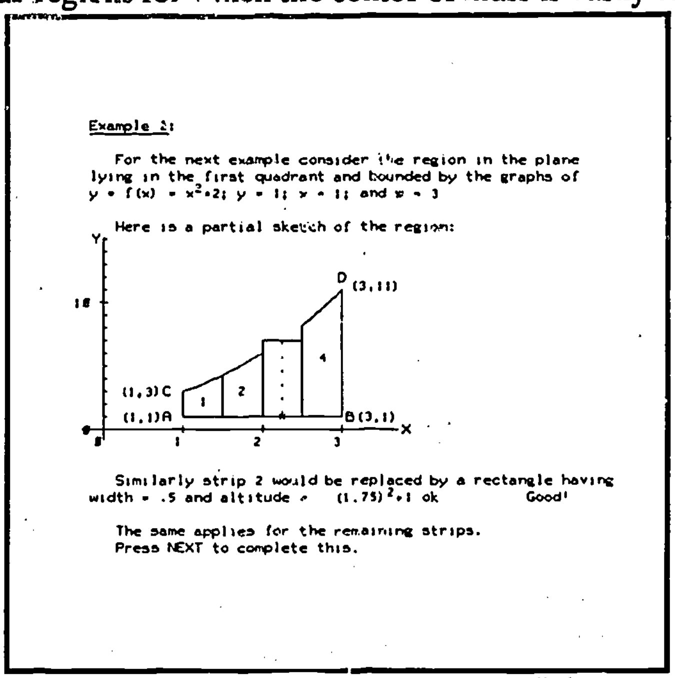


Figure 121. "Centers of Mass," by John Bergman and Mark Rogers. Copyright© 1981, 1982 by the University of Delaware.

In 1981, Dr. Clifford W. Sloyer received a Development in Science Education (DISE) grant from the National Science Foundation for a math enrichment project to develop a series of five modules dealing with practical applications of mathematics for motivated high school students. These modules are being prepared both in printed form and as CBI lessons that make use of the computational, graphical, and interactive capabilities of the PLATO system. The topics of the five modules are (1) dynamic programming, (2) mathematics in medicine, (3) queues, (4) graph theory, and (5) glyphs. All five lessons have been tested with students.

Figure 122 shows a situation in which a student is naming and determining the length of a path. As the student investigates each path, it is highlighted. Figure 123 shows a picture of Saturn plotted with eleven grey levels. Before solving the problem by using dynamic programming to reduce the eleven levels to the optimal three, the student guesses which levels result in the best detail and is shown the photo in the chosen shades.

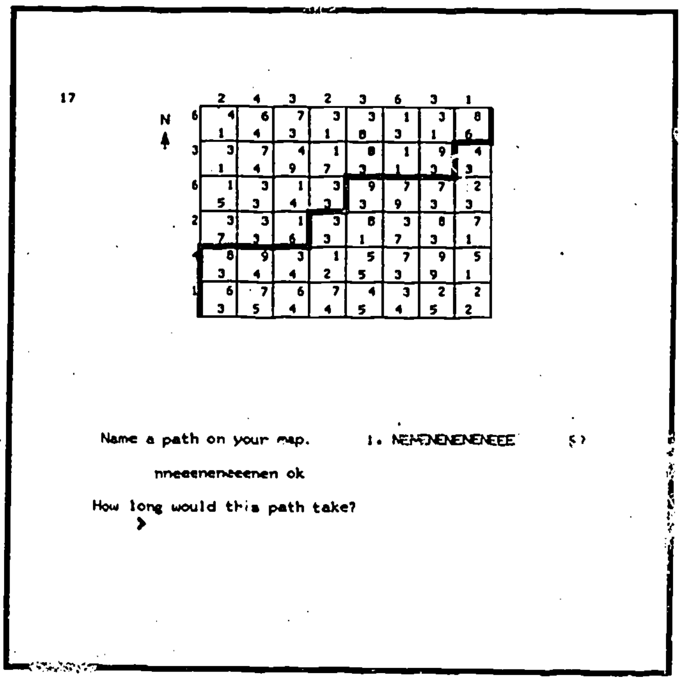


Figure 122. "Dynamic Programming," by Clifford Sloyer and Tri-Analytics,Inc. Copyright© 1982 by the University of Delaware.

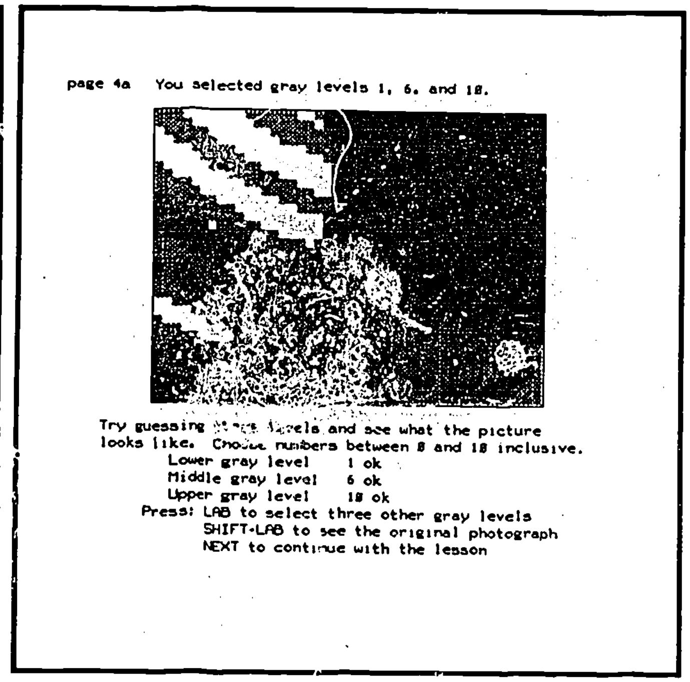


Figure 123. "Optimal Coding of Digitized Photographs," by Clifford Sloyer and Tri-Analytics, Inc. Copyright© 1982 by the University of Delaware.

Two of the mathematics enrichment lessons--"Glyphs" and "Queues"--have been converted to run on the Apple II. Each was divided into two programs that can be used independently. Figure 124 shows how the students can manipulate an anatoglyph in "Glyphs II." Figure 125 shows how "Queues I: Constant Arrival Rates" uses graphics and animation to help students visualize queueing situations.

In 1984, Dr. Sloyer received a second grant from the National Science Foundation to develop seven additional modules in applied mathematics. Topics include pattern recognition, information theory, clustering, mathematics in medicine, statistical bootstrapping, mathematical techniques in search, and modern developments in curve fitting. Each module will consist of a printed monograph and software, which will be developed for Apple II and IBM PC microcomputers.

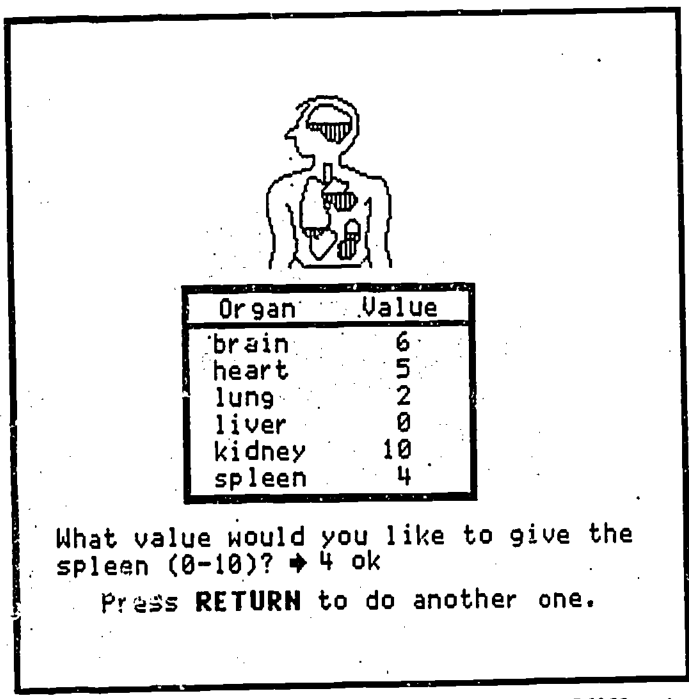


Figure 124. "Glyphs II," by Clifford Sloyer. Copyright© 1985 by the University of Delaware.

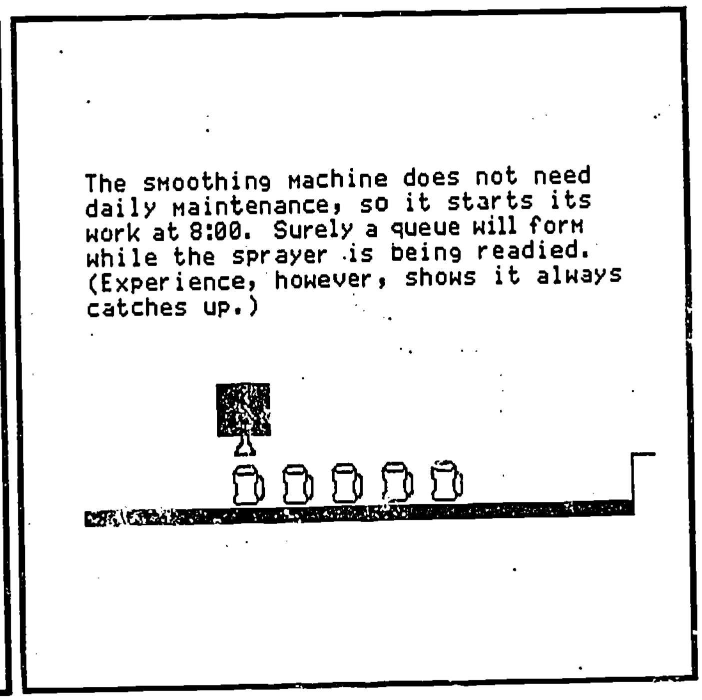


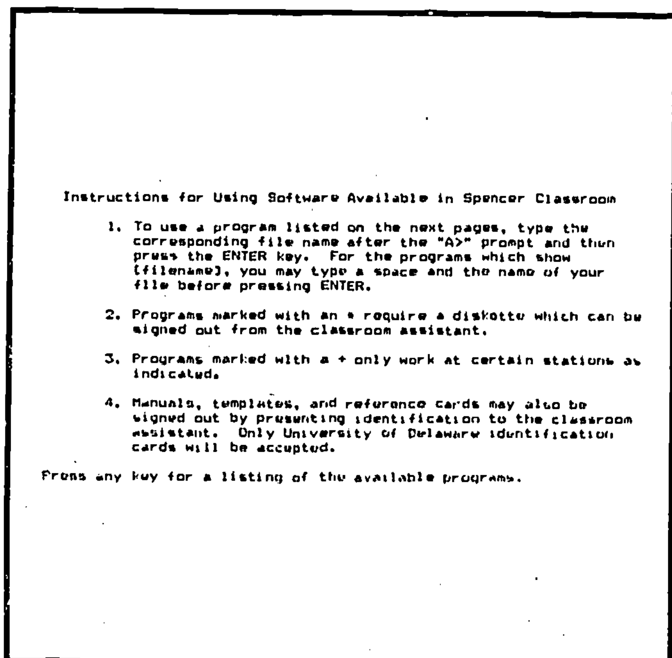
Figure 125. "Queues I: Constant Arrival Rates," by Clifford Sloyer. Copyright© 1985 by the University of Delaware.

Mechanical Engineering

During the fall of 1984, the Spencer IBM PC classroom was established in the George W. Laird Computer Facility. Ten personal computers in the classroom and two in faculty offices were connected by means of coaxial cable. Students began using the PCs to program in BASIC, FORTRAN, and Pascal; to do word processing using WordPerfect; and to study computer-based instruction lessons in geology and geography.

During the winter of 1985, 3COM Ethernet software was installed to make the network fully operational, and early in the spring a network version of WordPerfect and a multi-user version of dBASE II were installed.

Many other software applications are used in the classroom, including computer-aided design (CAD) applications, Lotus 1-2-3, FiniteGP, Brit, TK!Solver, LLNL Micro-CAE, PCWrite™, communications packages, and LINDO. Graduate and undergraduate student assistants are available to help users become familiar with this software and with the hardware, which includes a digitizer tablet, a plotter, mice, and printers. Figures 126 and 127 show screen displays that allow users to choose from a growing library of lessons and applications software.

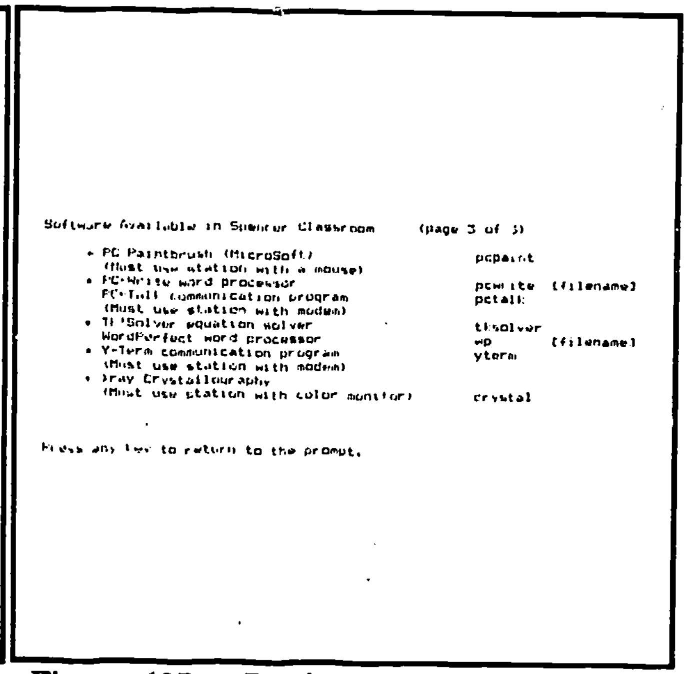


Instructions for Using Software Available in Spencer Classroom

1. To use a program listed on the next pages, type the corresponding file name after the "A>" prompt and then press the ENTER key. For the programs which show [filename], you may type a space and the name of your file before pressing ENTER.
2. Programs marked with an * require a diskette which can be signed out from the classroom assistant.
3. Programs marked with a + only work at certain stations as indicated.
4. Manuals, templates, and reference cards may also be signed out by presenting identification to the classroom assistant. Only University of Delaware identification cards will be accepted.

Press any key for a listing of the available programs.

Figure 126. Introductory Display for Users of the 3COM Ethernet in the Spencer Laboratory IBM PC Classroom.



Software Available in Spencer Classroom (page 3 of 3)

+ PC Paintbrush (MicroSoft) (Must use station with a mouse)	pcpaint
* PC-Write word processor	pcwrite [filename]
PC-Talk communication program (Must use station with modem)	pctalk
* TK!Solver equation solver	tksolver
WordPerfect word processor	wp [filename]
+ Y-Term communication program (Must use station with modem)	yterm
+ Xray Crystallography (Must use station with color monitor)	crystal

Press any key to return to the prompt.

Figure 127. Portion of the Software Listing Available to Users of the 3COM Ethernet in the Spencer Laboratory IBM PC Classroom.

PCWrite™ is the trademark of Quicksoft.

In response to faculty requests, classes are provided to introduce students to disk handling and use of the network. Sessions tailored to the specific needs of a course are also provided to familiarize students with the features of some of the more elaborate software packages, such as WordPerfect and Lotus®.

Use of the classroom has increased substantially during 1986. Students in Materials Science are using Computer-Aided Engineering (CAE) programs in crystallography and lever laws. Composite materials programs developed by the University's Center for Composite Materials are assigned to students in Special Topics: Designs with Composites. Mechanical Design students are using some of the programs from the LLNL Micro-CAE package to learn about the properties of shafts, springs, bearings, and other mechanical design elements. Students enrolled in Principles of Mechanics are programming in FORTRAN and BASIC, using the resulting data files as input to Lotus to produce graphs showing their results.

Lotus® is a registered trademark of Lotus Development Corporation.

Museum Studies

The Department of Museum Studies is developing a Macintosh program that will allow students to design a museum exhibit. Technical requirements are based on the gallery in Old College.

Figure 128 shows how students use the mouse to lay out the exhibit as a bubble diagram. After they edit and print the diagram, the students use MacDraft™ to produce a finished floorplan and elevation, such as the one shown in figure 129. MacDraft allows the user to rotate objects in the exhibit by as little as one degree increments. MacDraft produces automatic dimension lines and allows the user to see either a reduced or magnified view of the drawing.

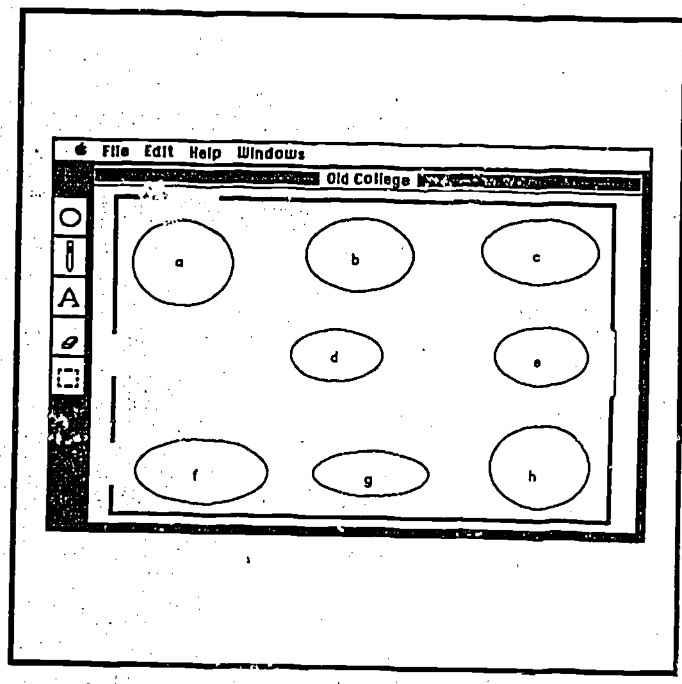


Figure 128. "Bubble Diagram," by Barbara Butler, Evelyn V. Stevens, and Penny Zographon. Copyright© 1985 by the University of Delaware.

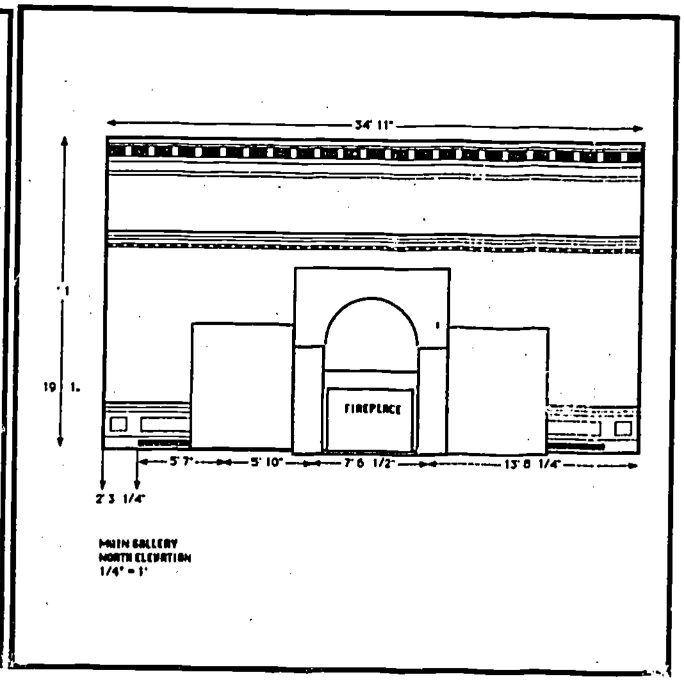


Figure 129. Drawing Done by a Student Using MacDraft.

MacDraft™ is a trademark of Innovative Data Design, Inc.

Music

The Department of Music has developed a package of music theory and ear-training lessons called the GUIDO Music Learning System, a videodisc music instruction series funded by the National Endowment for the Humanities, a home music learning system marketed by Atari, Inc., and a combined book and software package Making Music on Micros: A Musical Approach to Computer Programming published by Random House Software. It has also developed a music synthesizer card for use with the IBM PC and its compatibles. Each of these projects is discussed in turn as follows.

The GUIDO Music Learning System

Guido d'Arezzo is the eleventh-century musician and music educator who invented the staff and established the principles of solmization. Since he was the first real music educator, the GUIDO system has been named after him, using his first name as an acronym for Graded Units for Interactive Dictation Operations. The GUIDO system consists of two main parts, namely, aural skills and written theory.

Aural Skills. The first two years of ear-training have been organized according to levels of difficulty into graded units that form the basis of a competency-based curriculum that delivers drill and practice in intervals, melodies, chords, harmonies, and rhythms. Ear-training students spend an average of two hours each week at GUIDO learning stations, which consist of (1) a PLATO terminal and a digital music synthesizer, or (2) an IBM PC and a music adapter card. The average completion time is 120 hours.

When students enter one of the GUIDO programs, they are shown a list of the units in that program. The units they have completed have stars next to them. The goal is to get stars next to each unit. Each time a student completes a GUIDO unit, the computer writes a star next to that unit on the student's disk. Schools using GUIDO award an average of four credits upon successful completion of the units.

In the PLATO version, sound is generated by the four-voiced University of Delaware Sound Synthesizer. Each voice has thirty-two harmonics that can be independently controlled. Amplitude and frequency envelopes can be drawn on the screen to make both volume and pitch vary as a function of time. The IBM version uses a nine-voice plug-in synthesizer card that is reviewed later in this section. The Macintosh version uses the internal speaker of the Macintosh and the sound generation routines developed by Great Wave Software's "Concertware+"™. "Concertware+'s" "InstrumentMaker" can be used to define new GUIDO instruments. IBM and Macintosh versions are also MIDI compatible. The GUIDO system consists of five main programs: "Intervals," "Melodies," "Chords," "Harmony," and "Rhythm."

Concertware+™ is the trademark of Great Wave Software.

1. Intervals. Figure 130 shows a sample display from the "Intervals" program. At the top is a row of boxes that contain the names of musical intervals. GUIDO plays one of the intervals, and students respond by selecting the box that contains the interval they think was played. In the PLATO version, students select the box by touching it on PLATO's touch-sensitive screen; in IBM and Macintosh versions, they use a mouse. GUIDO keeps score, informing the students of how many intervals they have answered correctly and how many they need to do before they can pass the unit. Underneath the interval names are three columns of control boxes that are used to determine the way dictation is given. The instructor can preset them for the students, or the instructor can allow the students to set them at will. The first column of boxes allows for the intervals to be played as harmonic, melodic up, melodic down, or a mixture of melodic intervals up and down. The second column gives the option of fixing the top or bottom notes of the interval, or having them selected at random. In the third column of boxes the student can select compound or simple intervals, have an interval played again, and change the length of time the intervals last. Finally, the keyboard at the bottom of the screen is used to select top and bottom notes in the "fix top" and "fix bottom" controls. Figure 131 shows how the Macintosh version positions the keyboard in the middle instead of the bottom of the screen.

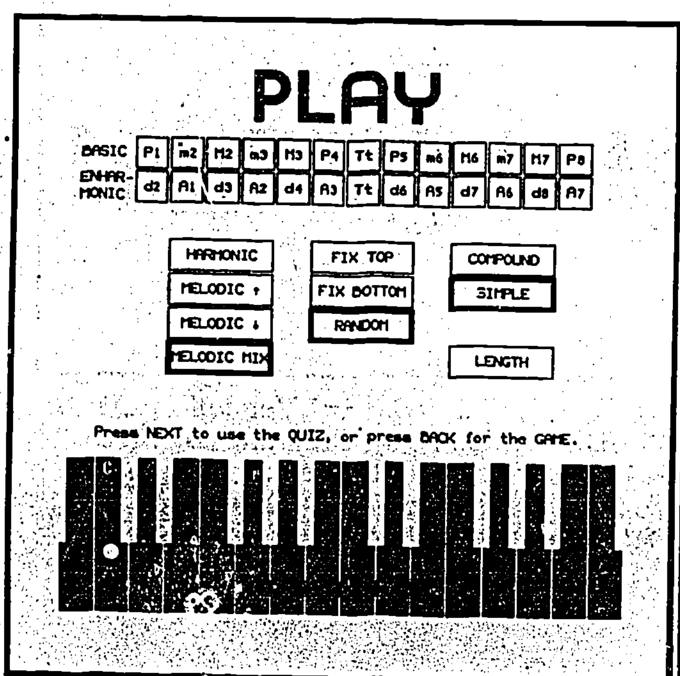


Figure 130. The PLATO Version of the GUIDO "Intervals" Program. By Fred T. Hofstetter. Copyright© 1977 by the University of Delaware.

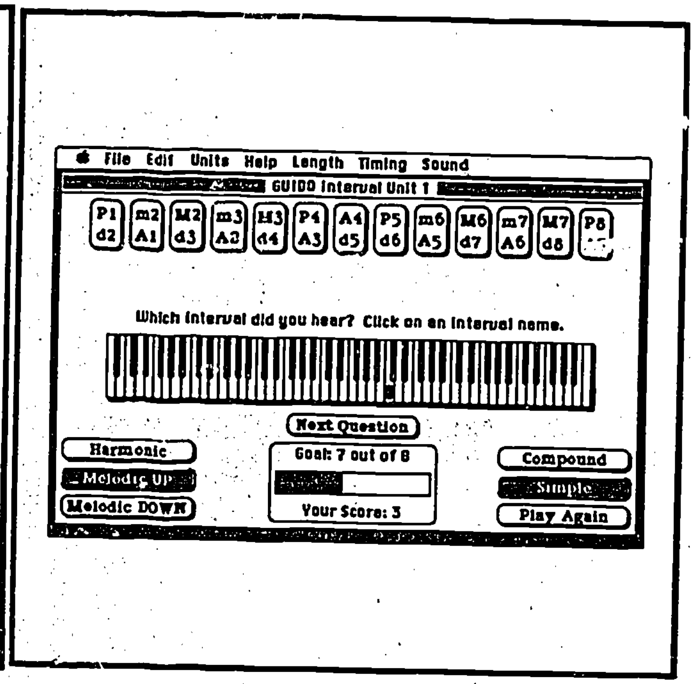


Figure 131. The Macintosh Version of the GUIDO "Intervals" Program. By Fred T. Hofstetter and Steven V. Bertsche. Copyright© 1986 by the University of Delaware.

2. Melodies. Figure 132 shows the main screen from the "Melodies" program. GUIDO plays a melody and asks the student to notate it by touching or clicking on the correct pitches. As the student enter the correct pitches, GUIDO writes them on the staff and sounds them for reinforcement. Notes can be entered in order from left to right, or the student can enter notes out of order and then go back to work on the ones that were skipped. The student can set the speed of dictation by selecting the SPEED box and can replay a question by selecting PLAY AGAIN. The "Melodies" program also includes options for entering notes with solfeggio syllables or by touching a keyboard like the one shown in figure 133.

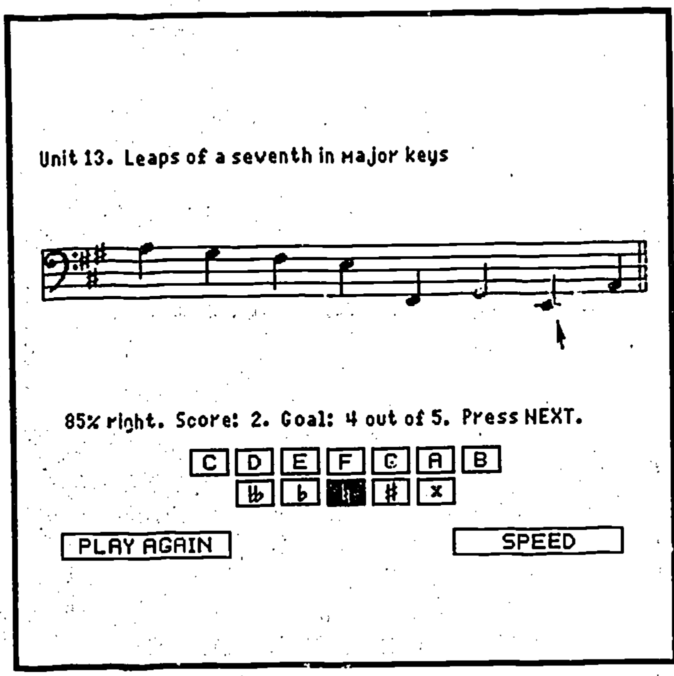


Figure 132. The IBM PC Version of the GUIDO "Melodies" Program. By Fred T. Hofstetter and Peter Whipple. Copyright© 1986 by the University of Delaware.

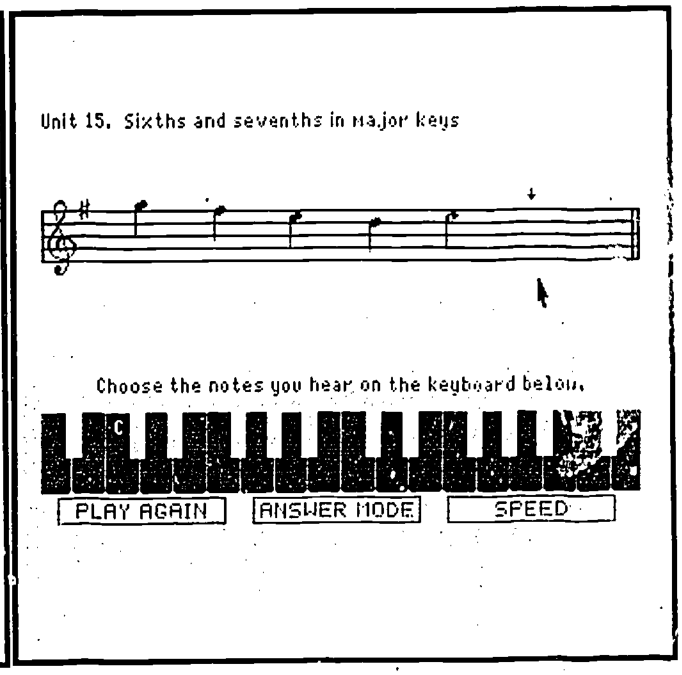


Figure 133. The IBM PC Version of the GUIDO "Melodies" Program. By Fred T. Hofstetter and Peter Whipple. Copyright© 1986 by the University of Delaware.

3. Chords. A sample display from the "Chords" program is shown in figure 134. GUIDO plays a chord and asks the student to touch both the quality and the inversion. By touching the control boxes at the bottom of the screen, the students can replay the chord, make GUIDO pause while they study a chord, change the mode of presentation to make the notes of the chord play up, down, and/or simultaneously, and change the length of time the chords are played. When a student gets the correct answer, GUIDO reinforces it by writing the notes of the chord on the staff at the top of the screen.

4. Harmony. Figure 135 shows the main screen from the "Harmony" program. GUIDO plays a four-part harmonic exercise in chorale style, and the student answers by touching Roman numerals and soprano and bass notes. As each note and Roman numeral is correctly answered, GUIDO notates it on the staff. The student can change the speed of dictation and replay the exercise. The volume of each voice can be changed, making it easier to hear the individual lines of the chorale. The style of playing can be changed from chorale style to various kinds of piano figures. By touching the sequence box, the student can change the order in which soprano, bass, and Roman numerals are answered. The student can also ask to answer alto and tenor voices. As with all of the GUIDO programs, the instructor can preset, disallow, or enable any of these student options.

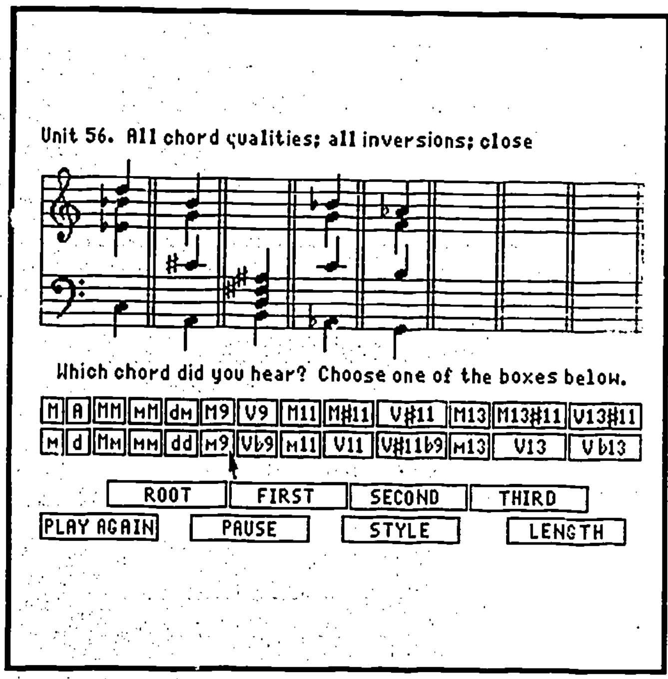


Figure 134. The IBM PC Version of the GUIDO "Chord Qualities" Program. By Fred T. Hofstetter and Peter Whipple. Copyright© 1986 by the University of Delaware.

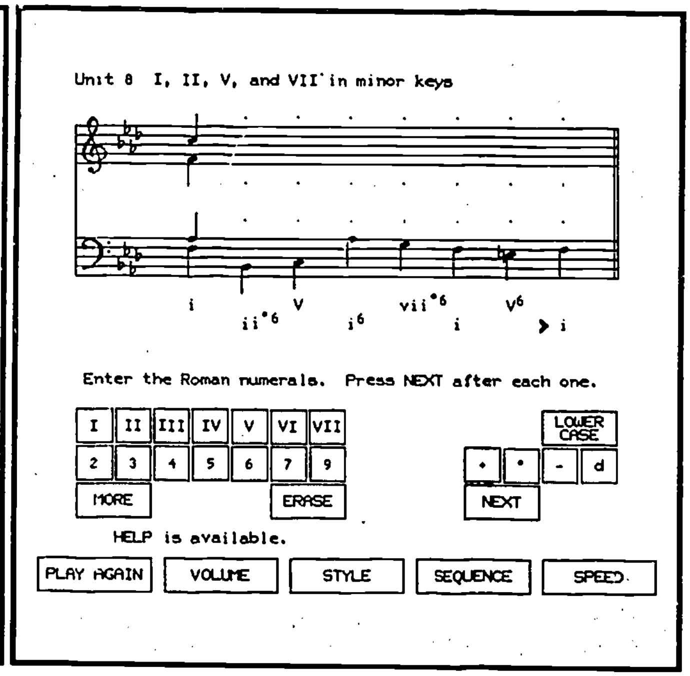


Figure 135. The PLATO Version of the GUIDO "Harmony" Program. By Fred T. Hofstetter and William H. Lynch. Copyright© 1978 by the University of Delaware.

5. Rhythm. Figure 136 shows a sample display from the "Rhythm" program. GUIDO plays a rhythm, and the student clicks the mouse in the boxes that correspond to the note values that were played. GUIDO displays each note value as the student gets it right, and the student has the option of changing the speed of dictation and of hearing the rhythm again. As with all of the GUIDO programs, the "Rhythm" program is able to handle many levels of difficulty, from the simplest rhythms using combinations of full beat values to complex rhythms employing irregular divisions and tied notes.

Written Skills. The written skills lessons run either on mainframe PLATO terminals or Micro-PLATO stations. Dealing with the fundamentals of music, they cover the following topics:

1. Note Reading
2. Half Steps and Whole Steps
3. Scales and Modes
4. Written Intervals
5. Beat Divisions
6. Rhythmic Notation
7. Key Signatures
8. Chord Functions
9. Partials
10. Transposition
11. Bass Figurization
12. Basic Part Writing

Figure 137 shows a display from the drill on chords in keys. GUIDO has asked the student to write a ii chord in the key of F major, and the student has responded by using the touch boxes to enter a correct SATB voicing. GUIDO has informed the student that there is more than an octave between the soprano and the alto. The student can press PLAY to hear the chord. For information about how to purchase the GUIDO system, see the Publication section of this report.

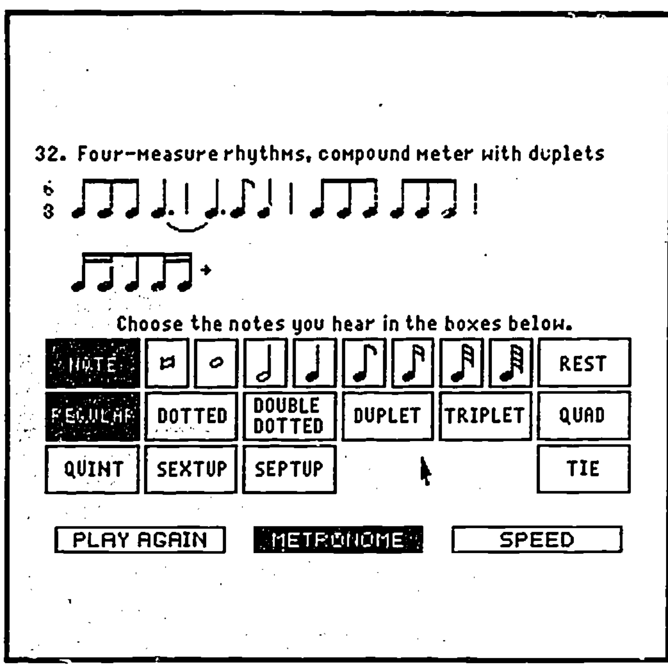


Figure 136. The IBM PC Version of the GUIDO "Rhythm" Program, by Fred T. Hofstetter and Peter Whipple. Copyright© 1986 by the University of Delaware.

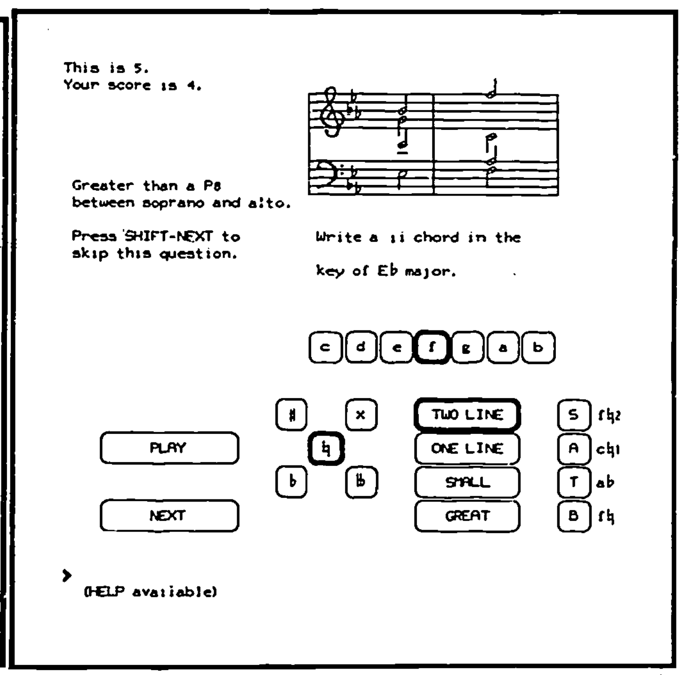


Figure 137. "Basic Part Writing," by Michael A. Arenson and Paul E. Nelson. Copyright© 1981 by the University of Delaware.

The University of Delaware FM Card

The University of Delaware manufactures a polyphonic sound card that plugs into one of the IBM PC's expansion slots. Based on Yamaha's FM (frequency modulation) chips, it can generate up to nine voices and has five percussion sounds. Table 9 lists its specifications. Each voice has a separate volume control.

Table 9--Specifications of the University of Delaware FM Card

Number of Voices:	9 simultaneous tones or 6 tones and 5 percussive sounds (bass drum, snare drum, high-hat cymbals, top cymbal, and tom-tom)
Frequency Output Range:	15 to 15,000 Hz
Tuning Accuracy:	16-bits ($\pm$1.66 cents)
Number of Channels:	1
FM Operators per Voice:	2
Number of Envelope Generators:	18 ADSR (2 per voice)
Special Features:	vibrato and tremolo oscillators, additive synthesis capability, keyboard scaling, adjustable volume headphone jack, RCA jacks

Videodisc Music Instruction Series

In the spring of 1982, the National Endowment for the Humanities awarded a $349,288 grant to the University of Delaware for the purpose of demonstrating how the random access capabilities of educational videodiscs can enhance the teaching of stylistic and theoretical concepts in selected musical masterworks. Four years later, the eight-sided Videodisc Music Series was published. Pressed in the CAV (constant angular velocity) format, it is designed for interactive use with a hand control or a microcomputer.

There are two main categories of materials on the discs. First, there are video performances of musical masterworks and supporting materials in the form of analyzed scores, contour maps, spectrum analyses, and demonstrations of keyboard actions, ornamentation, and modern and period instruments; second, there is an extensive slide bank.

Musical Masterworks. The content of the series was determined by considering (1) the frequency with which musical masterworks are used as examples in music appreciation, history, and theory textbooks; (2) the style periods in which the musical masterworks were written; and (3) their genre. Table 10 lists the musical masterworks that were chosen and the media in which they have been recorded. The video performance medium refers to a live video recording of the work with a stereo sound track. Analyzed score refers to a harmonic or melodic analysis that scrolls across the screen on a staff in time with the music. Scrolling score means that the notation moves across the screen without analysis. Contour analysis refers to a color-coded melodic contour diagram that scrolls across the screen as the music plays. An umbrella is a color-coded diagram of the form of a piece which, when overlaid at the top of a score, serves as a musical bookmark to show the listener what section is being played.

Table 10--Musical Masterworks in the Videodisc Music Series

Mozart, Quintet for Clarinet and Strings in A Major, K. 581, First Movement: video performance; analyzed score; contour analysis; ornamentation analysis.

Haydn, Symphony No. 94 in G Major, Second Movement: analyzed score.

Mozart, Piano Concerto Number 17 in G Major, K. 453, First Movement: video performance; scrolling score with umbrella diagram; alternate cadenza; period instrument demos.

Berlioz, Symphonie fantastique, Fifth Movement: video performance; scrolling score; Berlioz's program; Idée fixe statements from the first four movements; video performance of monks singing the Dies Irae chant; analysis of Berlioz's use of the chant.

Debussy, Prelude to the Afternoon of a Faun: scrolling analysis with umbrella diagram; modern instrument demonstrations; spectrum analyses.

Reichardt, Loewe, and Schubert, Three Settings of Goethe's Erlkönig: video performances; alternate interpretations of Schubert's Erlkönig; scrolling analysis of Schubert's Erlkönig.

Brahms, "Schaffe in mir Gott:" scrolling analysis.

Puccini, La Bohème (selected scenes): video interview of director Franco Zeffirelli; video performances of Rodolfo's aria "Che gelida manina," Mimi's aria "Mi Chiamano Mimi," the Dance Duel, and the Death Scene; synopsis; costumes; filmstrip "Backstage at the Met."

C.P.E. Bach, Fantasia in G Minor: video performance on a fortepiano; video performance on a clavichord; scrolling analysis; ornamentation demonstrations; keyboard action models.

Table 10 (continued)

Beethoven, Piano Sonata Opus 13 (Pathéique), Third Movement: video performance; scrolling analysis with umbrella diagram; reduction analysis; color-coded scrolling map.

Chopin, Polonaise Opus 53: video performance; scrolling analysis; scrolling score with umbrella diagram.

Slide Bank. An extensive slide bank has been pressed in exactly the same place on each disc so that each slide has the same frame number, regardless of which disc is being played. The slide bank contains pictures of the composers and their families, friends, teachers, patrons, and musical instruments; original manuscripts, early editions, program notes, and correspondence; homes, towns, and cities where the composers lived and worked; performance halls in which their works were played; and other musicians, artists, and writers who were active at the time. The slide bank also includes a collection of period instruments, the original costume designs for Puccini's La Bohème, and the Metropolitan Opera filmstrip Creating the Illusion: Backstage at the Met.

Instructor Guide. A two-volume Instructor Guide comes with the Videodisc Music Series. Volume I has six main parts. First, there are storyboards that provide an overview of what is included in the series and how it is laid out on the discs. Second, there are essays written by the editorial review board members who defined the scope and content of the series. Third, there is an index of the instrument demonstrations that are provided for modern and period orchestras. Fourth, there is a catalog that identifies each image in the slide bank. Fifth, there is a running list of frame numbers that will be helpful to those writing software to control the series. Finally, there is a technical appendix that discusses the equipment needed to use the discs. Volume II contains the scores of the musical masterworks; frame numbers have been written on the scores to facilitate random access to musical excerpts on disc.

Ordering Information. The Videodisc Music Series is published by the Office of Computer-Based Instruction at the University of Delaware in Newark, Delaware. The initial pressing of 200 copies is being sold for $295 per copy, which includes all four double-sided discs and the Instructor Guide. When this report went to press, 100 copies had been sold.

AtariMusic Learning Series

Under a grant awarded by Atari in 1982, OCBI took advantage of the built-in sound and graphics animation chips of Atari 400, 600, 800, and 1200 home computers and produced the AtariMusic Learning Series, which presents an integrated curriculum of tutorials, simulations, drills, competency tests, and music video games that teach note reading, whole and half steps, major scales, key signatures, and scalewise melodic dictation. Table 11 outlines the curriculum. There are twenty-two hours of instruction. Students can go through the materials in order or use menus to jump to any screen in the series. When students let the computer do the sequencing, a competency-based testing system makes sure they master one level before progressing to the next. Designed for lifelong learners, the AtariMusic series can be used by anyone of age nine or older.

Table 11--Outline of the <u>AtariMusic Learning Series</u>

AtariMusic I, Disk 1: Note Reading Strand

- Lines and Spaces
- Treble and Bass Clefs
- Ledger Lines
- The Grand Staff
- Note Attack Game

AtariMusic I, Disk 2: Whole and Half Step Strand

- Letters on the Keyboard
- Steps Between Letters
- Sharps and Flats
- Steps with Sharps and Flats
- Making Steps on the Staff
- Stepwise Transporter Game

AtariMusic II, Disk 1: Major Scale Strand

- The C Major Scale
- Major Scales in Other Keys
- Naming Key Signatures
- Writing Key Signatures
- Key Wars Game

AtariMusic II, Disk 2: Hearing Scalewise Melodies

- Instructions and Options
- Drills with Goals
- Answering with Letter Names
- Answering on the Keyboard
- Scale Degree Numbers
- Solfeggio Syllables

Making Music on Micros

In 1984-85, a new course was established--MU 287, Making Music on Micros. A thirty-unit curriculum begins with simple concepts like pitch and time and culminates in the programming of special effects in completed melodies. A 220-page book teaches musical and computer programming concepts in an individualized, step-by-step approach, and a floppy disk that contains fifty-three demonstration programs illustrates the text on the computer screen. Students load a program, learn how it works, and then use it in their own compositions.

At the heart of the Making Music on Micros curriculum are three computer commands called SOUND, PLAY, and DRAW. SOUND lets the student program the basic physical properties of frequency and time. The format of the SOUND command is

SOUND pitch,time

where pitch is the frequency of the note, and time is a number that tells how long the note will last. After mastering the basic concepts of pitch and time, the student uses the PLAY command to learn letter names, octaves, rhythms, tempo, articulations, and form. The PLAY command contains a string of letters and numbers that tell the computer what notes to sound. For example, this command PLAYs the first phrase of "Deck the Halls:"

PLAY "G4. F8 L4 E D C D E C"

After the student learns how to SOUND and PLAY the fundamentals of music, a 36-page tutorial on musical composition shows how to compose basic pitch and rhythmic patterns, manipulate them using techniques of melodic variation, combine them into phrases and periods, and compose an original folk song. The DRAW command comes next. A library of graphics subroutines is provided that helps the student DRAW compositions on the screen. As a final touch, the concluding chapters show how to program the special effects of pizzicato, tremolo, glissando, portamento, and vibrato.

The Making Music on Micros curriculum is published by Random House Software and runs on 48K Apple II computers, the IBM PC, and the IBM PCjr. The Apple and IBM PC versions have one voice; the IBM PCjr has three. Apple owners may wonder where the SOUND, PLAY, and DRAW commands come from, because Apple soft BASIC does not contain such commands. The Making Music on Micros disk adds them to the Apple; they are built into the IBM.

Nursing

The College of Nursing has developed clinical simulations for use in its adult physical health and illness and psychopharmacological nursing courses. These simulations allow students to practice analytical skills, priority setting, problem-solving, and decision-making in delivering appropriate patient care in response to lifelike client needs and provide a transition from classroom theory to clinical practice. Students can practice the nursing process without endangering client safety, making it possible to emphasize student learning over timely patient care. Students may work at their own pace and repeat the simulations as often as needed to learn appropriate nursing procedures.

In the situation shown in figure 138, a client has returned to his room from the operating room following an abdominal perineal resection. The student has been asked to identify one in a series of steps that should be taken in response to the needs of the client. The student has chosen one from a list of steps possible at that point. The computer has advised the student that another response would be more timely. In figure 139, the student has identified an appropriate step, and the simulation has supplied a reason for performing that step.

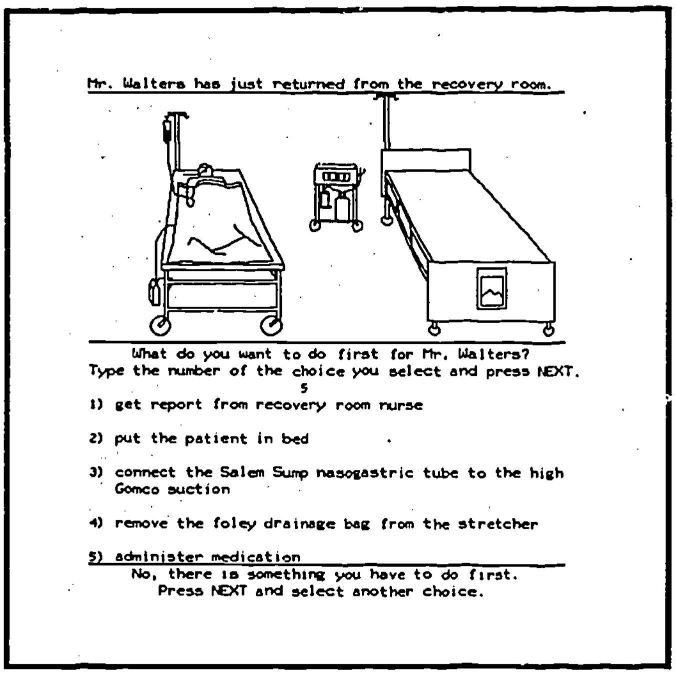


Figure 138. "Abdominal Perineal Resection: A Patient Care Simulation," by Mary Anne Early and Monica Fortner. Copyright© 1979, 1980 by the University of Delaware.

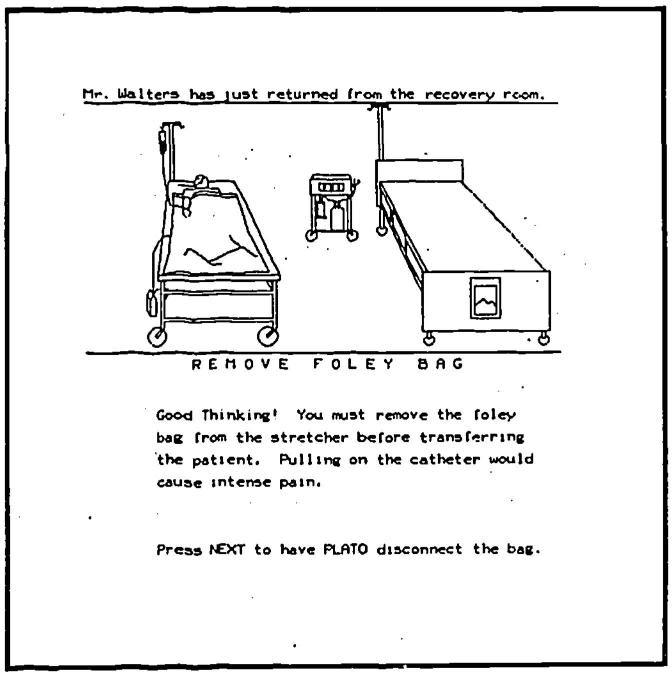


Figure 139. "Abdominal Perineal Resection: A Patient Care Simulation," by Mary Anne Early and Monica Fortner. Copyright© 1979, 1980 by the University of Delaware.

Figure 140 is taken from one of a series of simulations in which the student applies the steps of the nursing process in clinical situations. Students collect data on clients, make assessments based on the data, plan for their clients' care, decide which plans to implement first, and evaluate the outcomes of their interventions. In figure 140 a student made an unacceptable number of mistakes in considering which pieces of information were relevant to a particular assessment. Having kept track of the student's performance, the lesson now provides an appropriate study assignment.

Six client simulations have been implemented on the PLATO system. Formative testing of the last two lessons took place in the fall of 1981. The entire series was used for the first time by all students taking the course on adult mental health and illness during the spring of 1982. Data collected on student responses provided the basis for revision of the series from 1982-84. Two research studies of the effectiveness of the simulations were conducted, and the results have been published. For more information, see Boettcher (1984) in the Experimentation section of this report.

Professor Madeline Lambrecht was awarded a fellowship by the Center for Teaching Effectiveness under which she designed a lesson on death and dying. This lesson uses the interactive features of the PLATO system to encourage students to focus on a topic that most people are reluctant to confront. Individualized feedback and branching techniques allow responses to be handled at the level most appropriate for each student.

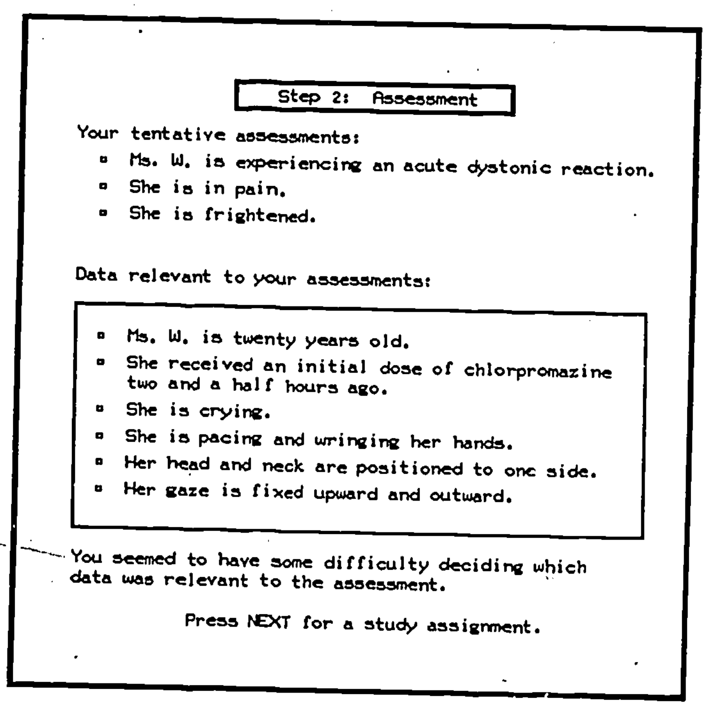


Figure 140. "The Nursing Process and Psychotropic Medication: Antipsychotic Medication," by Sylvia F. Alderson, Elaine Boettcher, Evelyn V. Stevens, Francis J. Dunham, and Miriam Greenberg. Copyright© 1986 by the University of Delaware.

In figure 141, a hypothetical Nursing student (Pat) has been asked to describe his feelings after having experienced a simulated terminal illness. The computer compares the student's response with an earlier response to a similar question and provides appropriate feedback, as shown in figure 142.

The College of Nursing continues to use the PLATO system to allow registered nurses to challenge nursing courses for credit by examination. Since 1978, multiple choice tests covering the theoretical portions of the first and second courses in adult physical health and illness have been used a total of fifty-two times by registered nurses studying for higher degrees.

Nursing students use the Apple and the IBM PC to learn and practice basic analytical and problem-solving skills required in patient care. The Lippincott programs "Behavioral Objectives," "Nursing Plans," and "Nursing Diagnoses" are helping students in the courses Societal Context of Nursing and Determinants of Wellness.

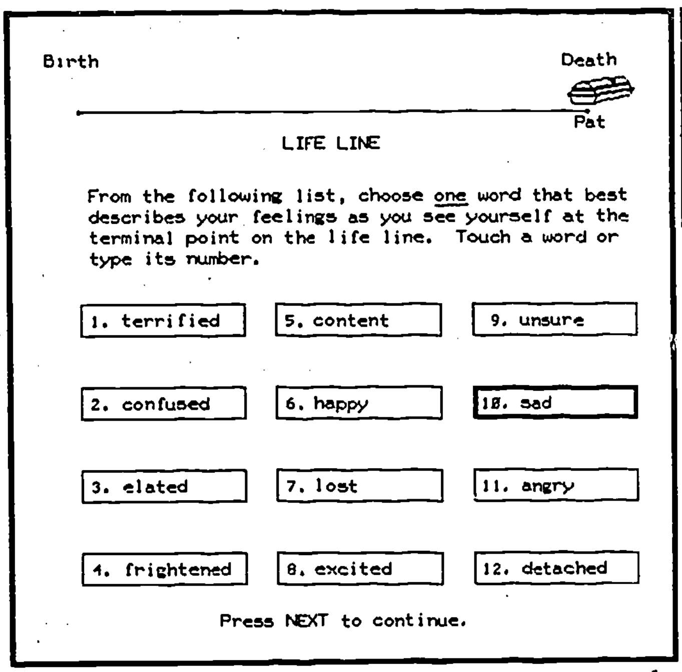


Figure 141. "Death: A Personal Encounter," by Madeline E. Lambrecht, Evelyn V. Stevens, and Miriam Greenberg. Copyright© 1986 by the University of Delaware.

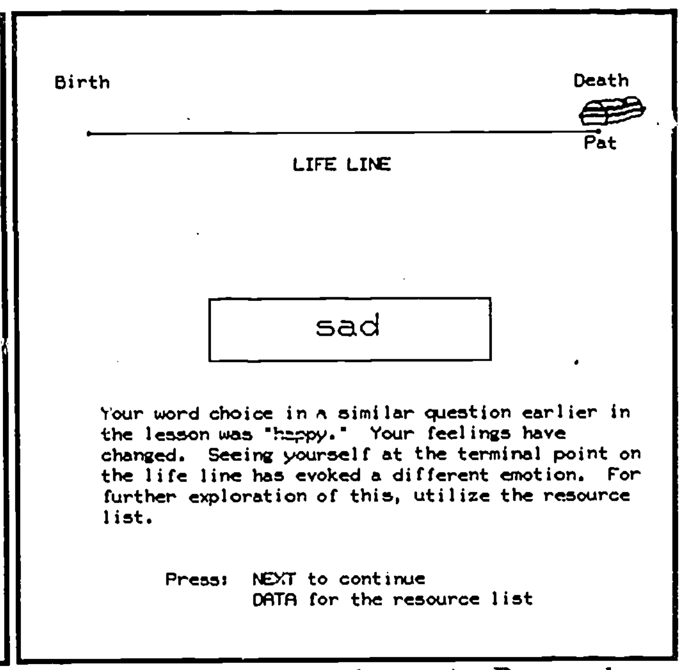


Figure 142. "Death: A Personal Encounter," by Madeline E. Lambrecht, Evelyn V. Stevens, and Miriam Greenberg. Copyright© 1986 by the University of Delaware.

Physical Education

The College of Physical Education, Athletics and Recreation has developed courseware in Sport Science, Sport Skills, Health, and Physiology.

Sport Science

"Film Motion Analysis," a lesson that uses a digitizer interfaced to a PLATO terminal, continues to be an integral part of the biomechanics program. Students enter body coordinates of nineteen segmental endpoints that have been acquired through the filming of athletes. The computer uses these coordinates to provide the students with a graphical representation of the body, location of center-of-gravity positions, and kinematic compounds of both linear and angular velocities. In addition, the angle is calculated for each vertex. This lesson has been published by the Control Data Corporation. Figure 143 is an example of a graphic display that is formed from data that the student has entered.

Another lesson developed in the sport science area is "Equine Biomechanics and Exercise Physiology." It uses the same biomechanical concepts as "Film Motion Analysis" but is more flexible because the student is not limited to nineteen segmental endpoints. After the student uses the digitizer to enter the chosen number of endpoints, the computer draws graphics similar to those of the "Film Motion Analysis" lesson. Figure 144 shows multiple frames of sample output for a horse.

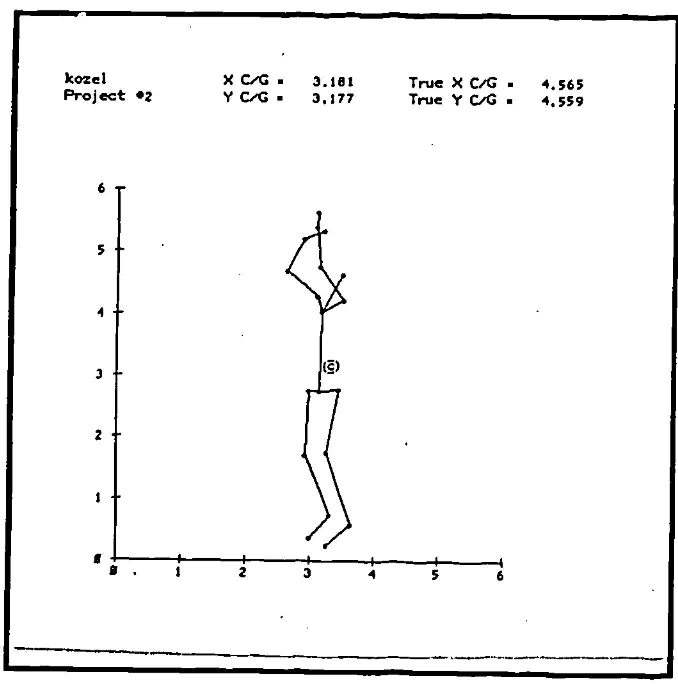


Figure 143. "Film Motion Analysis," by David Barlow, James Richards, and A. Stuart Markham, Jr. Copyright© 1977 by the University of Delaware.

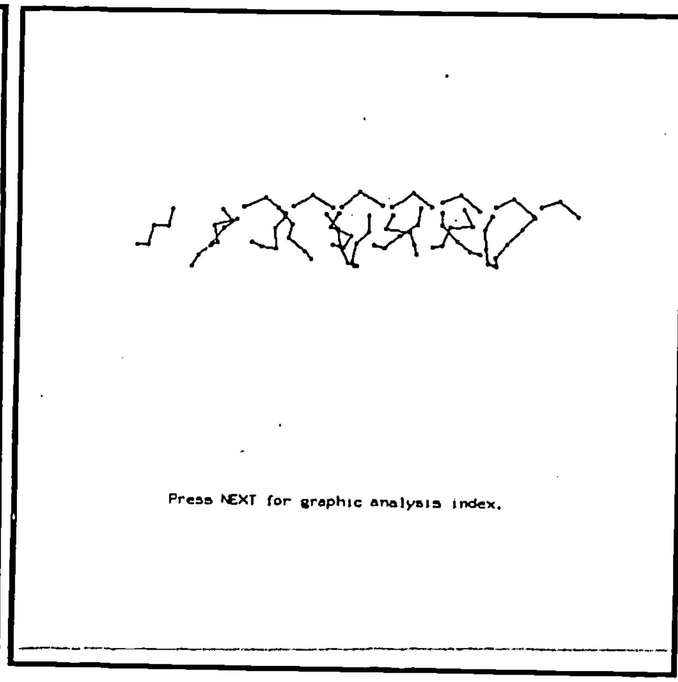


Figure 144. "Equine Biomechanics and Exercise Physiology," by David Barlow, Shawn Hart, Jeffrey T. Davis, and Mark Baum. Copyright© 1981, 1982 by the University of Delaware.

A Basic Mathematics and Trigonometry Package is used extensively to prepare students for the mathematics needed to complete biomechanics coursework. The programs provide examples of biomechanics formulae and terminology and drill and practice in the laws of signed numbers, balancing equations, formula transformation, proportionality, unit conversion, trigonometric functions, and vector motion analysis in sports. Pretests and posttests are included. Figure 145 shows a vector motion analysis problem, and figure 146 shows the detailed solution that is provided for students who cannot solve it on their own.

Sport Skills

A Volleyball Strategies Series is widely used in the sport skills area. The volleyball lessons begin with a tutorial on each volleyball strategy. After the tutorial, a volleyball court is drawn on the screen, and the student is informed of what the opponents are about to do. The student then positions players on the court by touching the screen. When all of the players have been set up, positioning is judged and appropriate feedback is given.

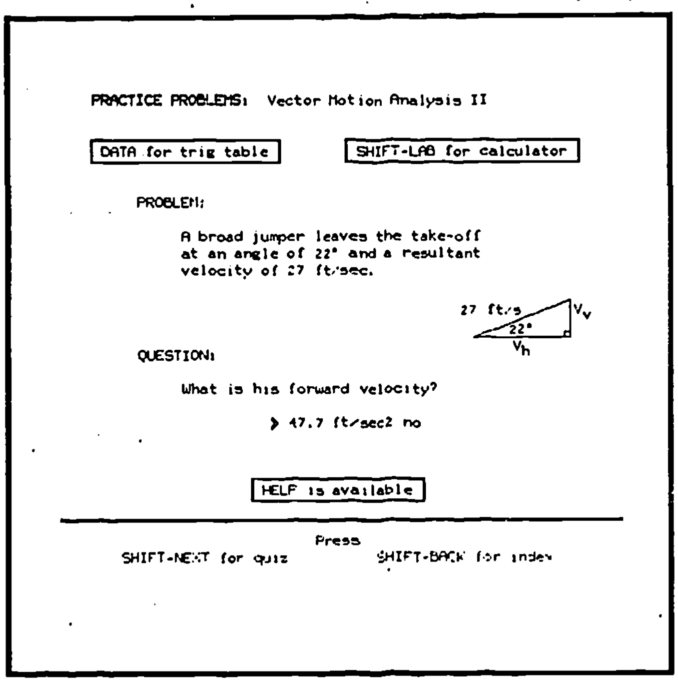


Figure 145. "Vector Motion Analysis in Sport: Part II," by David Barlow, Patricia Bayalis, and Nancy J. Balogh. Copyright©1981, 1983 by the University of Delaware.

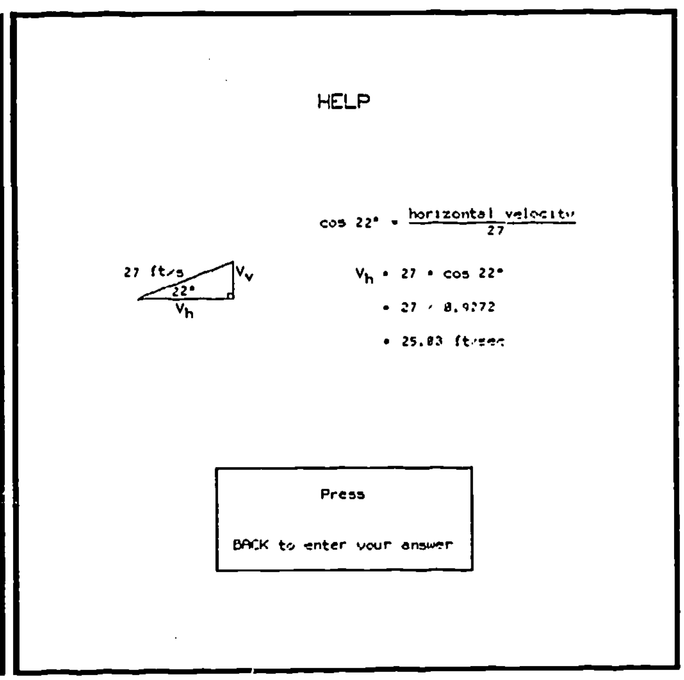


Figure 146. "Vector Motion Analysis in Sport: Part II," by David Barlow, Patricia Bayalis, and Nancy J. Balogh. Copyright© 1981, 1983 by the University of Delaware.

Figure 147 is an example of a court that a student set up.

Three lessons on doubles racquetball discuss offensive and defensive strategies for doubles play. Students learn court markings, positioning, and techniques of doubles play, which can be very hazardous for the beginning racquetball player, who has not learned to control stroke technique and has not mastered spatial awareness of the stroke space. Instructors feel obligated to teach doubles play strategies but are reluctant to let beginners play doubles matches. The PLATO lessons were developed to provide the opportunity for students to learn doubles play without the risk of injury. Figure 148 shows how one of these lessons uses PLATO graphics in discussing doubles strategies.

In addition to volleyball and racquetball, the sport skills area has also developed a lesson on social dancing. A musical example is played on a music synthesizer, and the student identifies the dance step that would be appropriate to use with the music. The dance steps include the alley cat, cha cha, charleston, disco, fox trot, jitterbug, polka, rhumba, tango, and waltz.

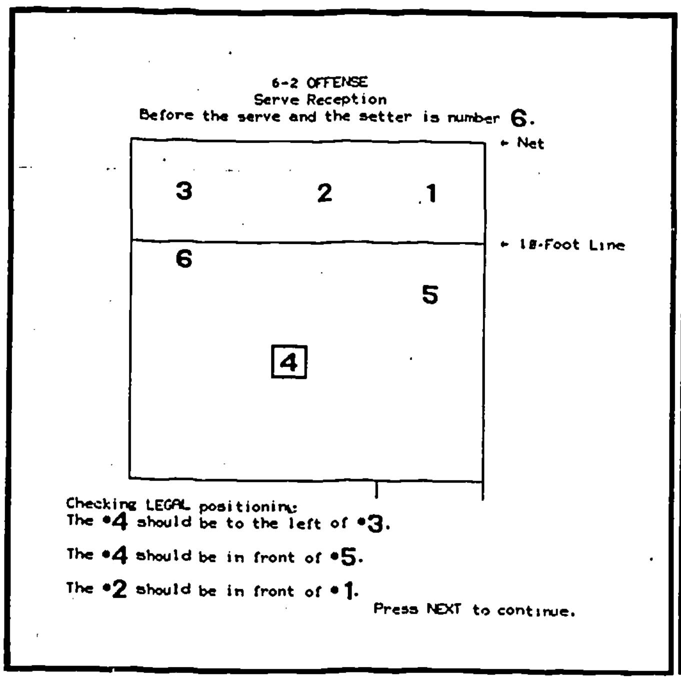


Figure 147. "Volleyball Strategy Lessons: A Drill and Practice Lesson Dealing with the 6-2 Offensive and 2-4 Defensive Strategies Used in Volleyball," by Barbara Viera, A. Stuart Markham, Jr., and Nancy J. Balogh. Copyright© 1980, 1981, 1982 by the University of Delaware.

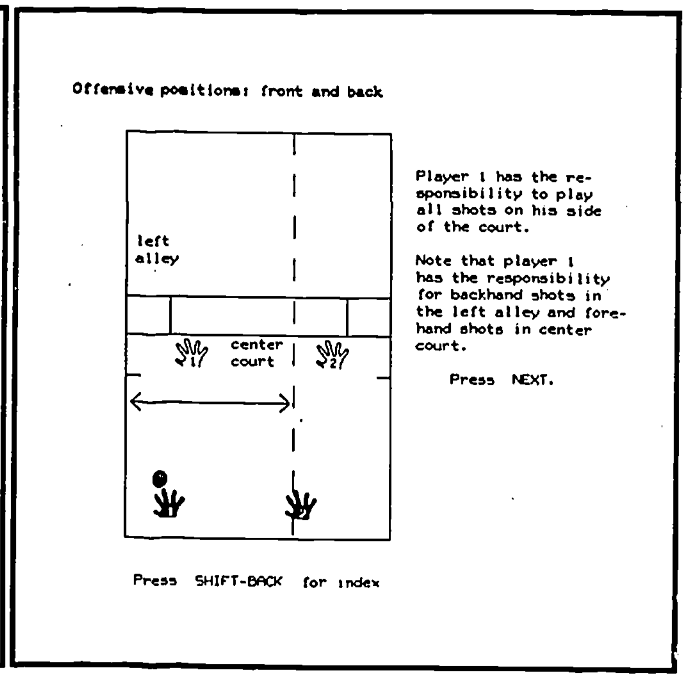
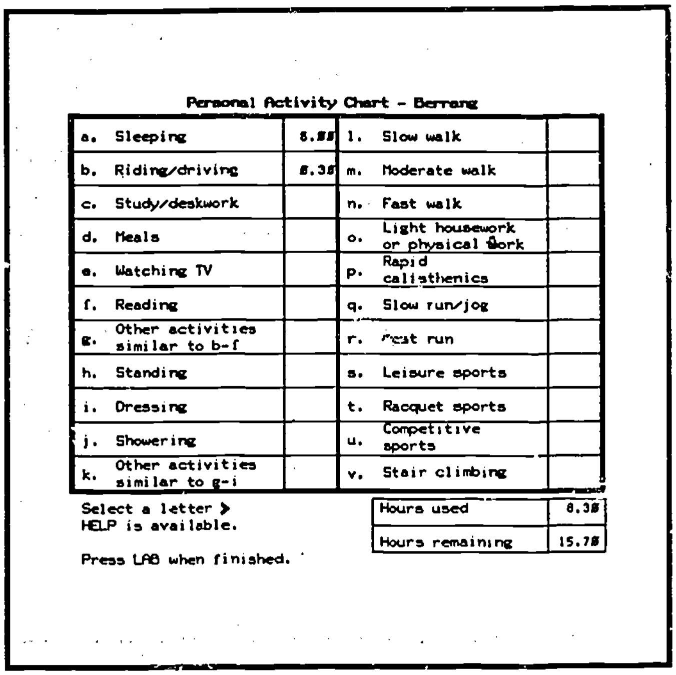


Figure 148. "Basic Racquetball Strategies for Doubles Play: Offensive Positions," by James Kent, Patricia Bayalis, Clare Berrang, Nancy J. Balogh, and Eric Bishop. Copyright© 1980,1982, 1983 by the University of Delaware.

Health

Health lessons under development include activity assessment and fitness lessons. The activity self-assessment lesson analyzes a student's daily exercise routine and determines whether more exercise is needed to be physically fit. Students are asked to identify activities they have done during the day and enter the number of minutes each activity lasted. Figure 149 is an example of how students break down a 24-hour day into various activities. After students enter all of the activities they have done, the information is analyzed, and results are explained.

The fitness series has become an integral part of the sport skills classes in physical education. With the emphasis these classes place on lifetime sports and physical fitness, it is important for students to understand the basic principles of fitness. The series begins by discussing the importance of the threshold level and the proper procedure for monitoring pulse rate; it continues by outlining the ingredients of an effective fitness program and eventually aids students in establishing personalized physical fitness programs. Figure 150 explains the pulse monitoring procedure students practice during the lesson.



Personal Activity Chart - Berrang

a.	Sleeping	8.00	l.	Slow walk	
b.	Riding/driving	0.30	m.	Moderate walk	
c.	Study/deskwork		n.	Fast walk	
d.	Meals		o.	Light housework or physical work	
e.	Watching TV		p.	Rapid calisthenics	
f.	Reading		q.	Slow run/jog	
g.	Other activities similar to b-f		r.	Fast run	
h.	Standing		s.	Leisure sports	
i.	Dressing		t.	Racquet sports	
j.	Showering		u.	Competitive sports	
k.	Other activities similar to g-i		v.	Stair climbing	

Select a letter ➤
HELP is available.

Hours used	8.30
Hours remaining	15.70

Press LAB when finished.

Figure 149. "Activity Self-Assessment," by Barbara Kelly and Deborah E. Richards. Copyright© 1981, 1982 by the University of Delaware.

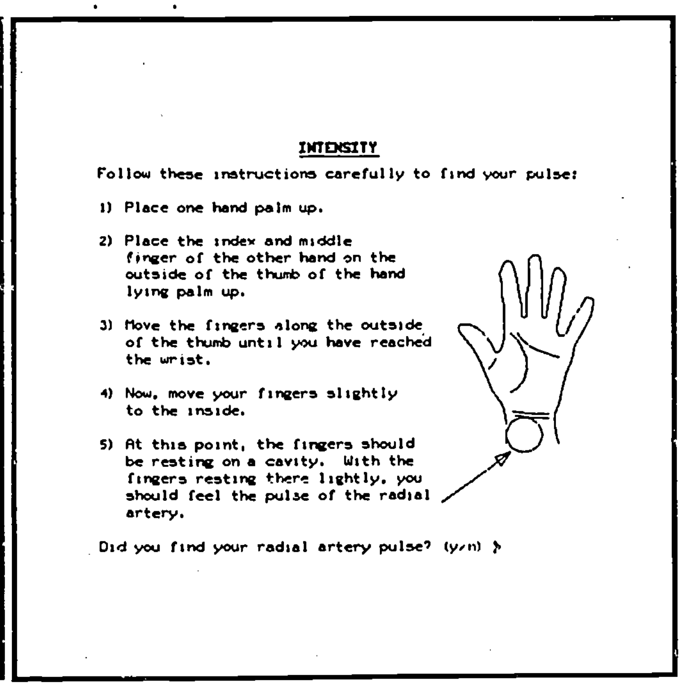


Figure 150. "Fitness, Part 2: Ingredients of Fitness," by John O'Neill, Deborah E. Richards, Patricia Bayalis, Sharon Correll, Clare Berrang, and Sherri Giniger. Copyright© 1981, 1982, 1983 by the University of Delaware.

Physiology

Two physiology lessons have been developed. The first deals with muscle identification and is presented in a multiple choice, drill and practice format that quizzes students on identifying the action, origin, insertion, and innervation of the muscles of the human body. The addition of a series of slides is planned to help students incorporate new terminology. Figure 151 shows a sample question.

The second lesson deals with the mechanics of muscular contraction and explains cellular and molecular physiology by using animation to illustrate the processes that occur in the sarcomere, the cellular contractile element of a muscle fiber. A Micro-PLATO animation is used in this lesson to illustrate the intricacies of muscle contraction. Figure 152 shows the last of a series of displays demonstrating the principal processes of a contracting muscle. After successfully completing this lesson, students are able to name and identify the neurotransmitters, ions, and cellular processes involved in the contraction of a muscle fiber.

During 1985-86, physical education students began to use IBM PC microcomputers. Students in the course Computer Use in Health, Physical Education, and Recreation learned BASIC programming and used a software package called MicroUse, an integrated program that contains (1) a word processor closely resembling WordStar, (2) a spreadsheet much like Lotus, and (3) a data base manager that parallels dBASE II.

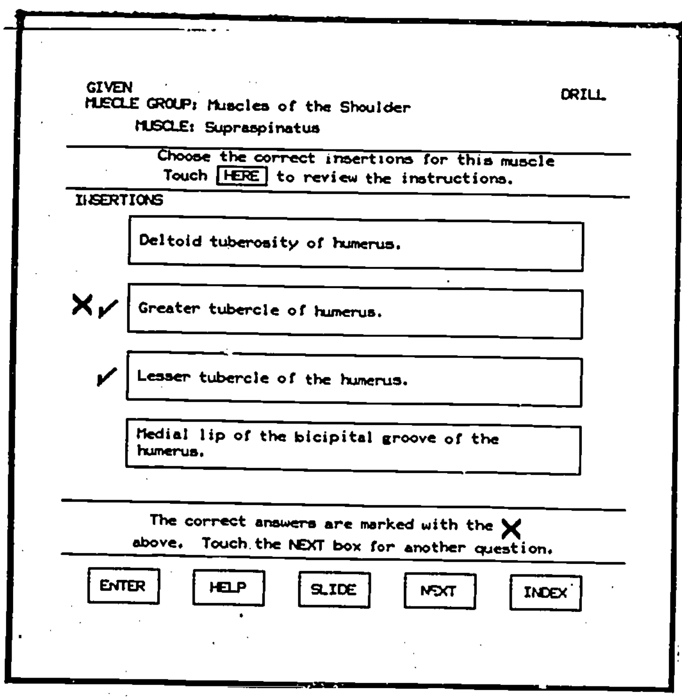


Figure 151. "Muscle Identification," by Keith Handling, Shawn Hart, and Patricia Bayalis. Copyright© 1980, 1982, 1983 by the University of Delaware.

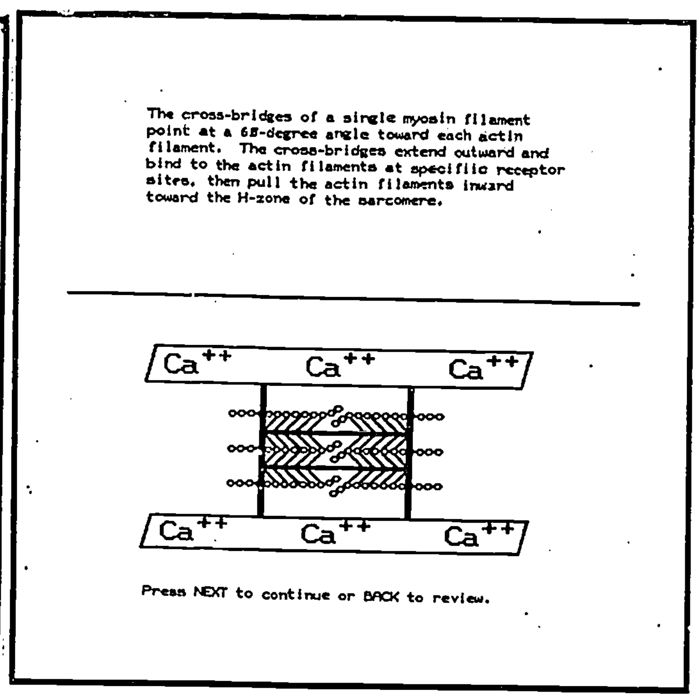


Figure 152. "The Mechanics of Muscular Contraction," by Robert Neeves, A. Stuart Markham Jr., and Shawn Hart. Copyright© 1984 by the University of Delaware.

Physics

The Department of Physics participated in the development of Control Data Corporation's Lower Division Engineering Curriculum. Consultants in program development included Professors Richard Herr, Arthur Halprin, and S. B. Woo. Professor Herr also served on the editorial review board. The physics component of this program covers material in the two semesters of general physics that undergraduates normally take at the beginning of an engineering curriculum. The lessons consist mainly of problem-solving exercises, tutorials in how to do problem-solving, and drill-and-practice exercises on basic concepts. The lessons are flexible enough to stand alone, supplement a lecture course, or replace the recitation sections that normally concentrate on homework problems. The laboratory experience included in the usual general physics course remains classroom-based and does not include PLATO lessons.

Physics students also use PLATO lessons in the Introduction to Astronomy course. Figure 153 is from an easily accessible table of the positions of the planets on any date, in right ascension and declination. Microcomputers are also used in the astronomy course. The Department of Physics became involved with microcomputers when faculty members and researchers began using personal computers for grading and numerical computation. The Commodore PET became especially popular. Instructional programs on the Commodore include an interactive problem-solving lesson on the luminosity of stars, several lessons on Kepler's laws, some astronomy terminology games, and several utility programs that students use to analyze laboratory data.

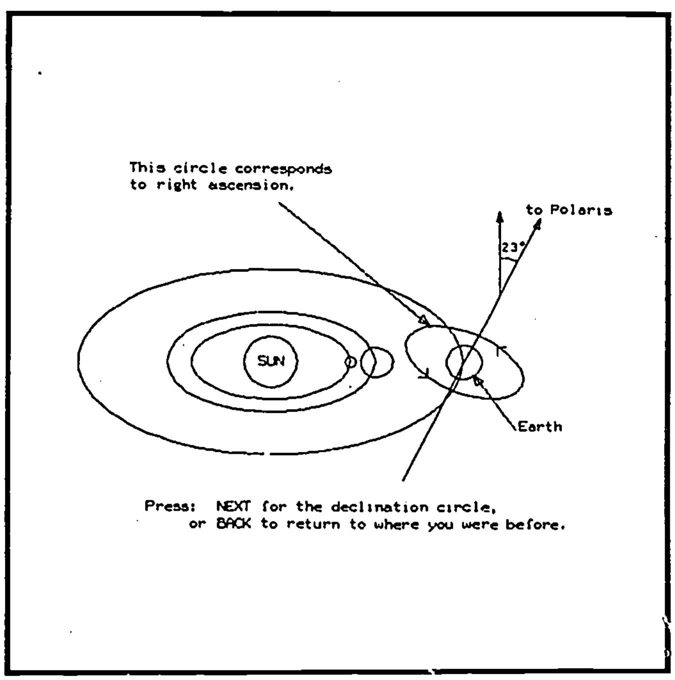


Figure 153. "The Positions of the Planets," by Samuel Lamphier. Copyright© 1980, 1981 by the University of Delaware.

Political Science

Under a grant from the National Science Foundation, Dr. Richard Sylves of the Department of Political Science revised three PLATO simulations based on lessons originally developed on the Illinois PLATO system. These lessons allow students to make strategic decisions in the policy process while assuming the role of a key actor in the policy subsystem.

In the first simulation, "Political Science Budget Lesson," students play the role of a state agency head for the Department of Mental Health. They complete budget forms for their departments and then shepherd the budgets through several stages in the state budgeting process, as shown in figure 154. The students must deal with pressures from the governor, hospital administrators, and key legislators, whose districts are served by particular hospitals; students must also be prepared to justify to the Bureau of the Budget any requested increases in their budgets.

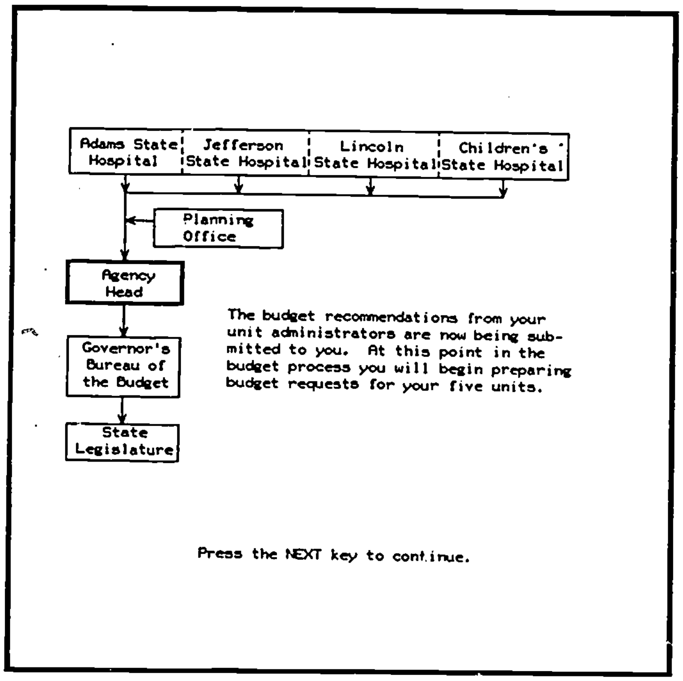


Figure 154. "Political Science Budget Lesson," by Fred Coombs, et al. Revised by Richard Sylves, Sue C. Garton, Walter Smith, and Randall Smith. Copyright© 1971 by the Board of Trustees of the University of Illinois.

The second and third simulations are called "Political Districting" and "Committee Chairman," respectively. In "Political Districting," the students practice drawing district maps and learn about the political significance of gerrymandering, as shown in figure 155. "Committee Chairman" deals with politicking in the state House of Representatives. The object is to influence House members to vote a particular bill into law. One way to do this is to choose appropriate witnesses who will testify in favor of the proposed bill at a hearing, as shown in figure 156. Throughout the simulation the students are shown a vote count taken by informal polls. The number of votes in favor, opposed, and undecided are shown periodically to inform students of their progress. At the end of the lesson the students are shown the margin by which their bills passed or did not pass, and they are given examples of some of the good and poor decisions they made during the lesson.

Another lesson, "Organization Charts and Public Administration," introduces the common principles of organization in understanding the formal organization charts of public agencies. Charts of real and imaginary organizations are depicted. Key terms and concepts that are commonly used in constructing formal administrative structures are introduced. The lesson also discusses the advantages and disadvantages of different organizational structures.

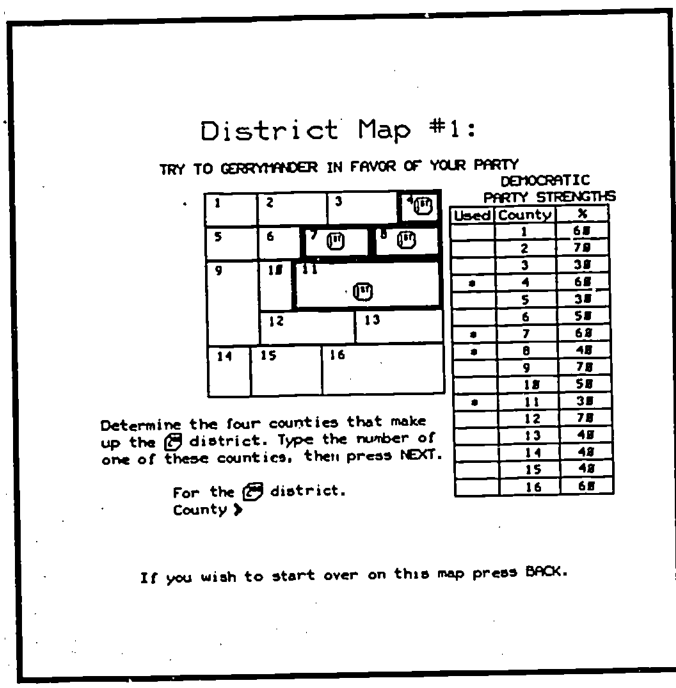


Figure 155. "Political Districting," by Don Emerick. Revised by Richard Sylves, Sue C. Garton, Randall Smith, and Susan Gil. Copyright© 1976 by the Board of Trustees of the University of Illinois.

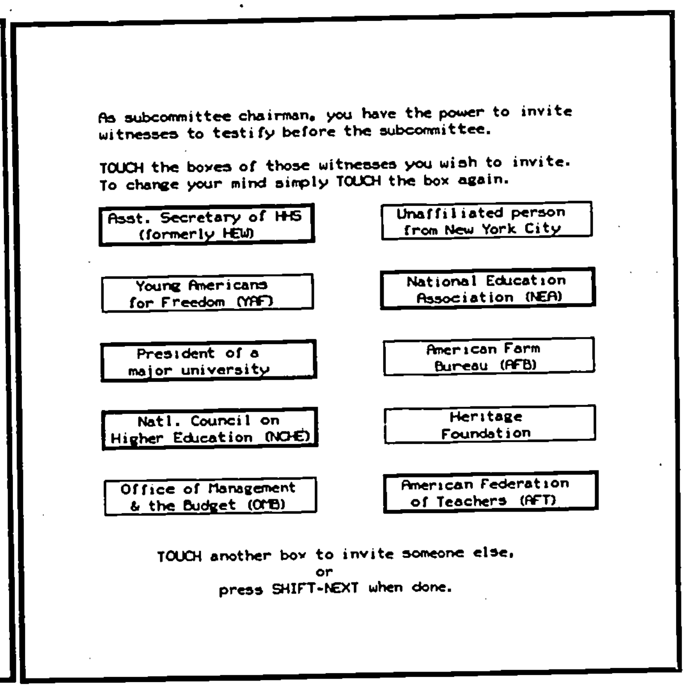


Figure 156. "Committee Chairman," by Fred Coombs, et al. Revised by Richard Sylves, Sue C. Garton, Kenneth Kahn, and Randall Smith. Copyright© 1969 by the Board of Trustees of the University of Illinois.

Psychology

Students in a Cognition course use the Willard Hall Apple Classroom to learn the rationale and methods for designing and implementing a research project. The "Computer Lab in Memory and Cognition" package lets the students see the experiments they engage in predict and support theories of cognition. It consists of programs in which students participate in simulated experiments.

A theory discussed in class is tested in the program "Levels of Processing I," which presents an experiment to assess the level at which subjects mentally process visual stimuli. Figure 157 shows the directions. The subject is asked a question, presented with a word, and asked to respond "yes" or "no." The questions are either semantically oriented (e.g., "Is it a kind of fruit?"), physically oriented (e.g., "Is it a consonant-vowel-vowel-consonant word?"), or acoustically oriented (e.g., "Does it rhyme with chair?"). These questions are designed not to test knowledge of the words, but rather the time required to respond, which is the dependent variable. The subjects are later asked to recall the words.

Figure 158 shows the results obtained by one student. They support the Levels of Processing Theory, which argues that people process information at different levels. The level at which the information is processed influences memory. Questions about the physical structure and acoustic characteristics of the word are processed at a shallower level than semantic questions and are not as successfully retained in memory. Questions concerning the meaning of the word should aid the subject in recalling that word at a later time.

The "Computer Lab in Memory and Cognition" package contains experiments that use independent variables such as the time lapse between questions. All the experiments deal with current issues in cognitive psychology courses.

```
IN THIS EXPERIMENT YOU WILL BE ASKED
TO ANSWER THREE KINDS OF QUESTIONS
ABOUT CERTAIN WORDS:

   IS IT A CVCVC?
   DOES IT RHYME WITH (SOME WORD)?
   IS IT A (SOME CATEGORY LABEL)?

ONE OF THESE QUESTIONS WILL APPEAR,
FOLLOWED BY A SINGLE WORD.
AT THAT POINT, YOU SHOULD RESPOND
'YES' OR 'NO' DEPENDING UPON WHICH
IS CORRECT. (EXAMPLES FOLLOW.)
-------------------------------------
   WHAT KEYS DO YOU WANT FOR:
   YES<RETURN>? S        NO<RETURN>?
```

Figure 157. "Computer Lab in Memory and Cognition," by Janice Kenon. Copyright© 1982 by Conduit, Iowa City, Iowa. Used by permission.

YOUR OWN DATA SUMMARIZED
(10 POSSIBLE PER TYPE)

QUEST. TYPE:	ENCODING #CORRECT	PHASE RT	RECOG. #CORRECT
TRUE. FORM	10	1101	8
FALSE. FORM	8	996	5
TRUE. RHYME	10	611	10
FALSE. RHYME	9	840	7
TRUE. CATEGORY	9	920	10
FALSE. CATEGORY	10	1011	10

FALSE RECOGNITIONS = 22

Figure 158. "Computer Lab in Memory and Cognition," by Janice Kenon. Copyright© 1982 by Conduit, Iowa City, Iowa. Used by permission.

Sociology

During the spring of 1979, the Department of Sociology began using the PLATO system as an educational aid in a course on population dynamics. This course uses a group of lessons developed by the Population Dynamics Group at the University of Illinois. These lessons interact with a large data base of information on population growth, energy consumption, food supply, and other variables related to population dynamics, for different time periods and countries. Students can change parameters and observe how these changes affect the population over time.

The two displays shown below are from a lesson on population projection. Figure 159 shows how a student can change a population variable and observe the results in bar graphs. Following the student's instructions, the lesson displays on the left side of the screen what the population of Belgium would be in 1990 if a dramatic increase in the fertility rate were to occur, whereas the projection given the present value of that parameter is shown on the right side of the display.

Figure 160 shows how the student can compare the projections for two different countries. In this case, the student has asked to see the projections for the populations of Belgium and Afghanistan using current demographic parameters. As with the previous example, the student can change the demographic variables and observe the effects on the populations.

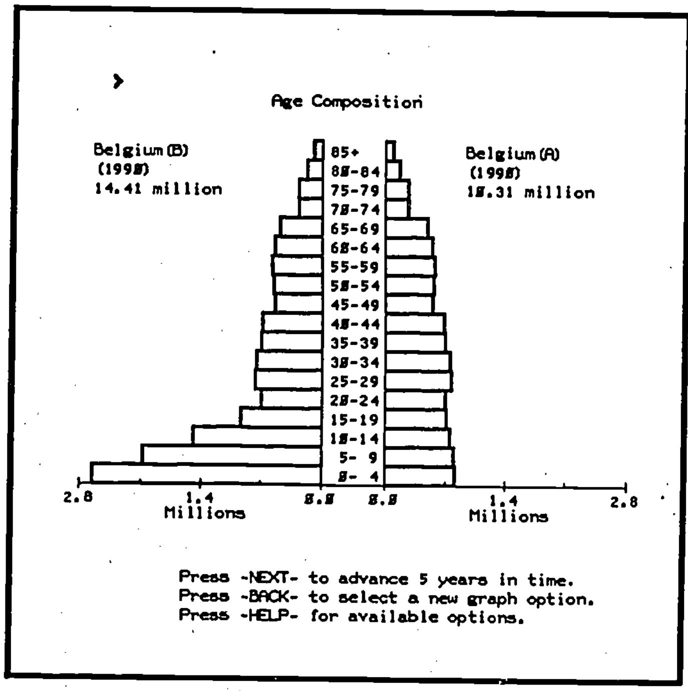


Figure 159. "Population Projections," by Populations Dynamics Group. Copyright©1975 by the Board of Trustees of the University of Illinois.

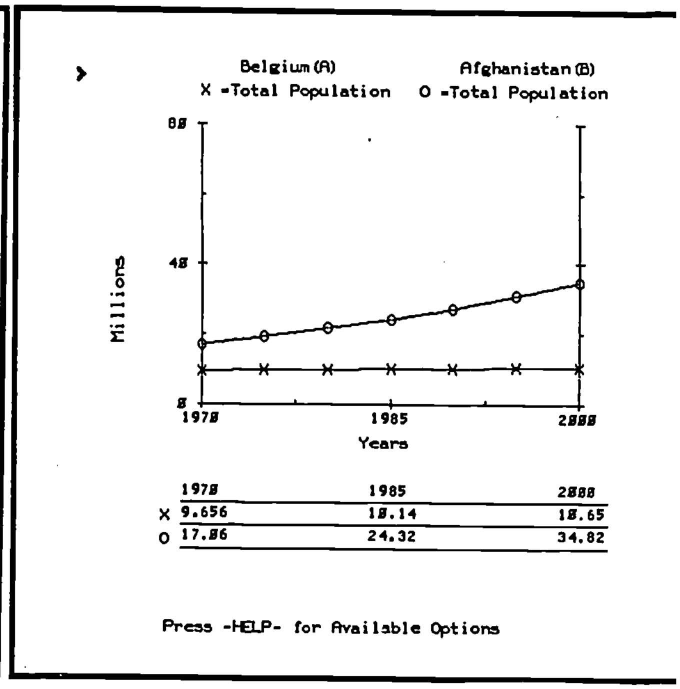


Figure 160. "Population Projections," by Populations Dynamics Group. Copyright© 1975 by the Board of Trustees of the University of Illinois.

Statistics

OCBI supports statistics courses on two mainframe systems, namely, PLATO and the VAX 11/780.

PLATO Statistics Courses

The Delaware PLATO system provides users with statistics instruction and data service. A statistics worksheet lesson has been developed that takes advantage of PLATO's high resolution graphics. Figure 161 shows a linear regression plot from this lesson. The data, entered in a worksheet format of rows and columns, is conveniently indexed, cross-referenced, statistically tested, and compared. Students obtain a display of the values of a given column of data as a table of values, as a box plot, or, as shown here, as a scatter plot. Pertinent parameters are displayed along with the graphical display.

A complete library of instructional statistics lessons developed at the University of Illinois is available on the Delaware PLATO system. Interested students and faculty may use Illinois packages to perform analyses of their own data. Graduate students find the instructional lessons helpful for review of fundamentals of statistical analysis, while researchers appreciate the ease with which results are obtained for small amounts of data.

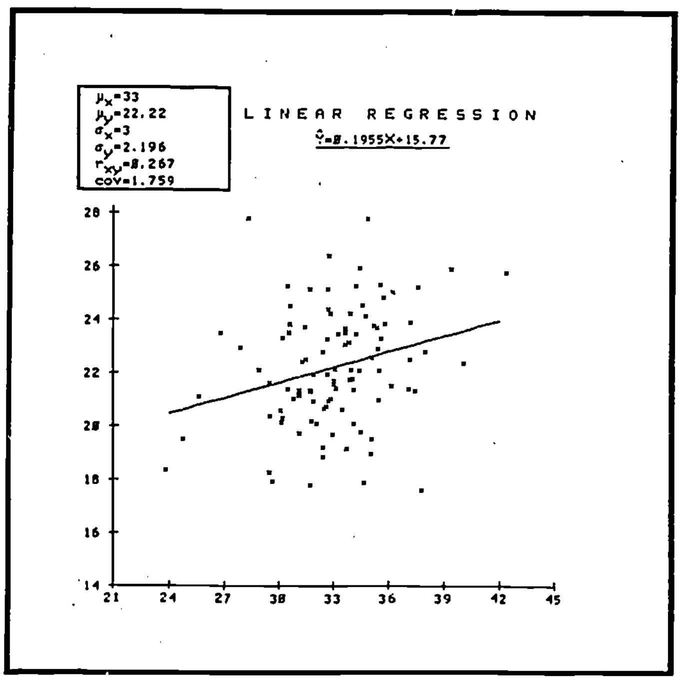


Figure 161. "Statistics Worksheet," by Victor Martuza, Aart Olsen, Mary Jac Reed, and Gary A. Feurer. Copyright©1981 by the University of Delaware.

VAX Statistics Courses

Three integrated statistics projects have been developed on the VAX 11/780. Under a grant from the Digital Equipment Corporation, Professors Arthur Hoerl and John Schuenemeyer of Mathematical Sciences, and Victor Martuza of Educational Studies, have developed a one-semester, interdisciplinary statistics course that includes lessons on probability, descriptive statistics, and inference. Basic statistics concepts are taught in a tutorial mode, and many graphical procedures and dynamic data bases are provided to illustrate concepts. Instructors may tailor these lessons by entering their own data bases and choosing statistical symbols familiar to their students. A glossary of statistics terms is available to the students at any point in the lessons.

An expanded index page, shown in figure 162, gives students full control of their paths through the statistics lessons. Students can do the complete tutorial lesson or simply drill terms or solve exercises on the material presented in each section. Figure 163 is an example of the complex graphical displays students construct in the "Exploratory Data Analysis" lessons; a back-to-back bar chart format illustrates personal crime rates in 1974 for selected cities in the United States.

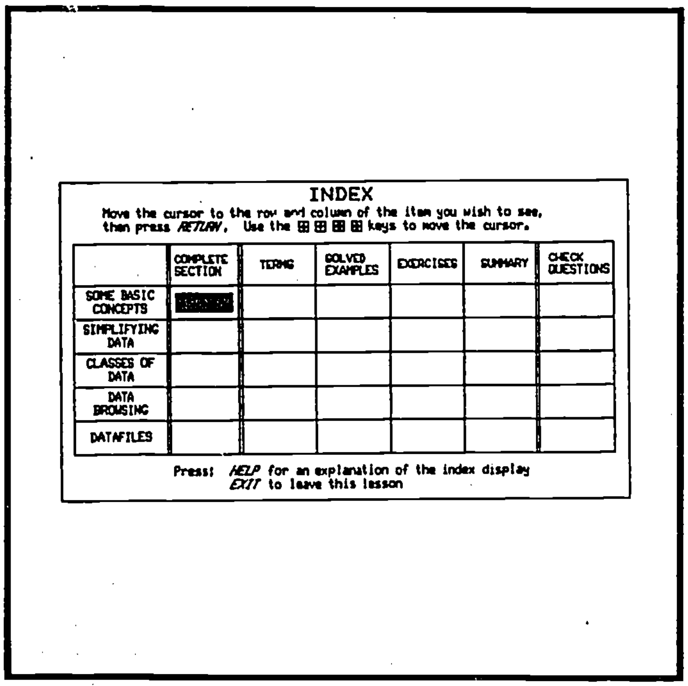


Figure 162. "Looking at Data," by Victor Martuza, Mary Jac Reed, and Michael Porter. Copyright© 1986 by the University of Delaware.

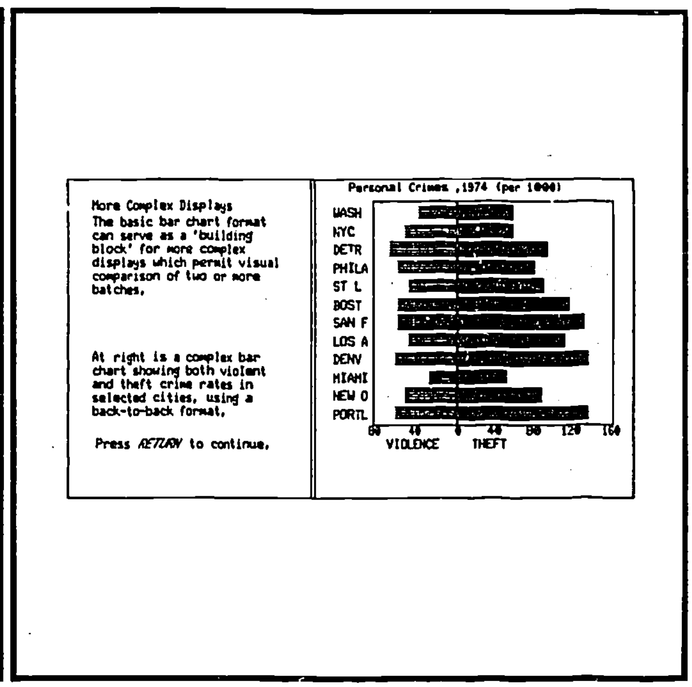


Figure 163. "Graphical Displays Based on Tallies," by Victor Martuza, Mary Jac Reed, and Michael Porter. Copyright© 1986 by the University of Delaware.

Figure 164 illustrates a probability problem. After being shown an experiment that involves drawing a heart from twelve face cards, students are asked to enter the numbers applicable to the equation. Figure 165 shows an open-ended exercise in which students control the display by choosing the confidence interval and alpha level. Subsequent queries test student understanding of the resulting plot.

Two other statistics projects have been funded by RFP (Request for Proposal) grants from OCBI. Five faculty members from the Departments of Communication, Criminal Justice, Political Science, and Sociology are developing a package of lessons to teach students how to collect research data, understand it, and critically evaluate it. Programmed lessons contain instructional information on scientific variables, the scientific method, and statistical research methods.

Finally, the APL programming language is being modified to use a friendlier, more understandable symbol notation with a faster terminal response time. Statistics students can construct programs from a library of APL functions and will eventually have graphical output from the functions. Tutorials in AMPL (A Modified Programming Language) are being developed to teach students how to use this powerful language for statistical analysis.

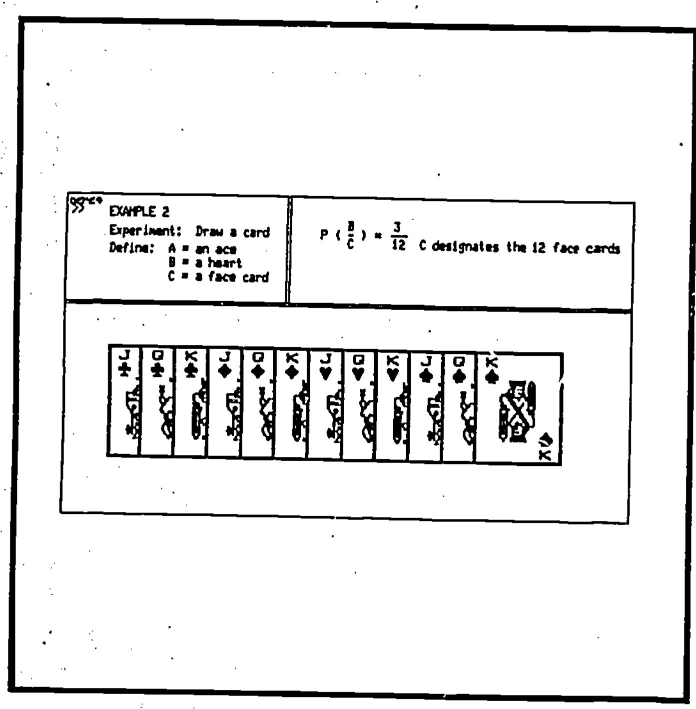


Figure 164. "Probability," by Arthur Hoerl, Clella B. Murray, and James C. Lynch. Copyright© 1986 by the University of Delaware.

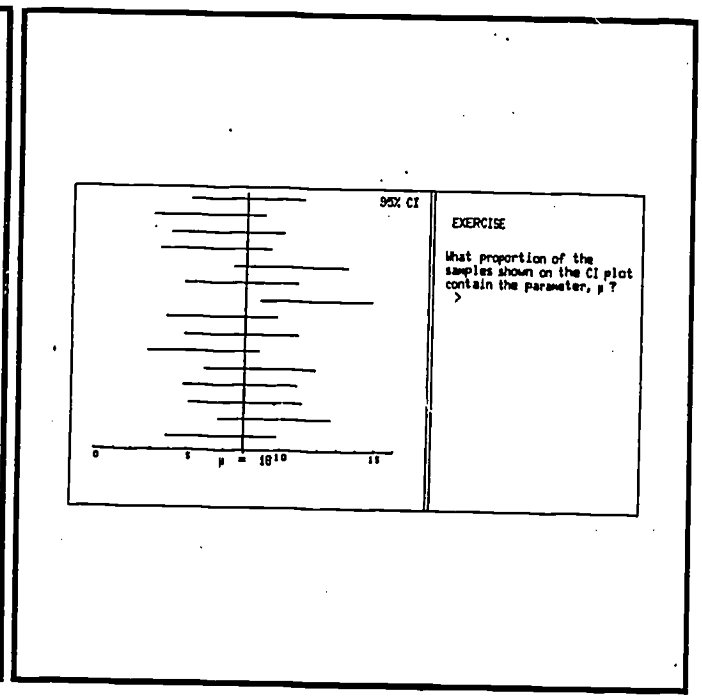


Figure 165. "Estimation Procedures," by John Schuenemeyer, Mary Jac Reed, and Deborah Bamford. Copyright© 1986 by the University of Delaware.

University of Delaware English Language Institute

The University of Delaware English Language Institute (UDELI) offers an extensive English program to sixty students each month from Panama, Japan, Brazil, Greece, Iran, Mexico, Jordan, China, Korea, Kuwait, Lebanon, Saudi Arabia, United Arab Emirates, Syria, Bolivia, Venezuela, Sri Lanka, Thailand, and Uruguay. Students are placed in one of five levels according to their language abilities.

At the core of the Institute's PLATO curriculum are "Basic Reading and Language Skills" for use by students at the lower levels and the "Index of English Lessons" for intermediate and advanced students. In the beginning sections, students work with the sounds of letters. In figure 166, the student learns whether the letter "c" is pronounced like "k" or "s." In the advanced section, students are given PLATO assignments that help develop skills needed in University courses. In figure 167, the student is presented with the verb stem "look" and is shown endings that change the verb to present tense, past tense, and present participle; then the student is given new verb stems and is asked to add the correct endings to form other tenses. The Institute also sponsors a group notesfile called "UDELI News," which students use with the stipulation that all notes must be written in English.

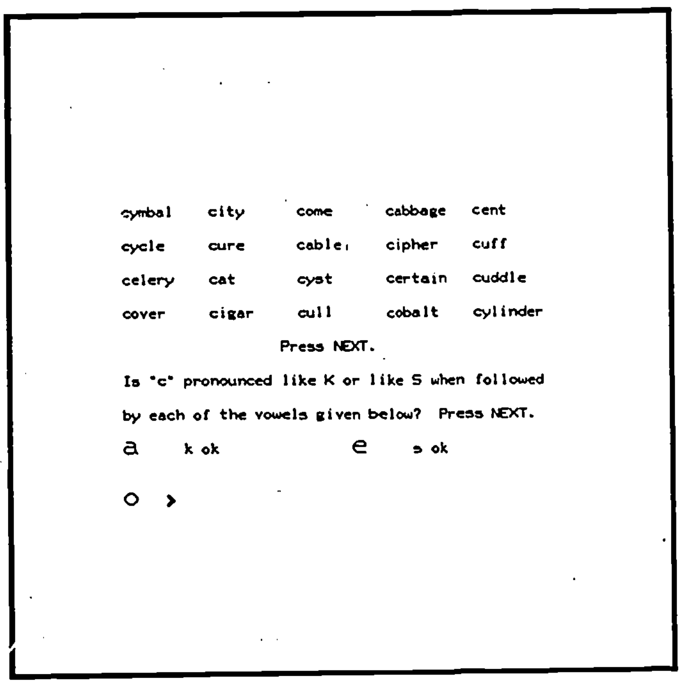


Figure 166. "The Case of the Curious C," by Joan Sweany. Copyright© 1975 by Chicago City Colleges.

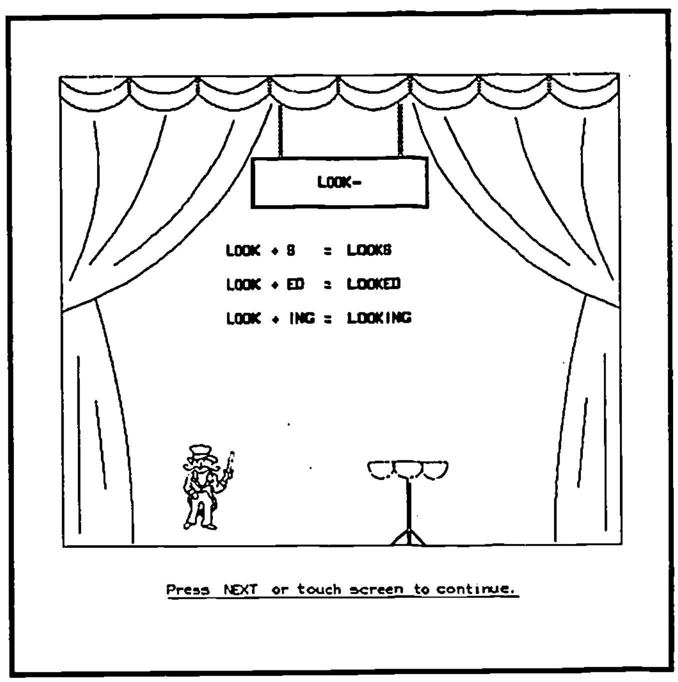


Figure 167. "Simple Verb Endings," by Robert Caldwell and Research for Better Schools. Copyright© 1979 by Control Data Corporation.

University Parallel Program

Computer-based instruction began in the University Parallel Program when four PLATO terminals were installed at the Georgetown campus of Delaware Technical and Community College (DTCC) during the fall of 1980. In 1982, eight terminals were installed in a CBT classroom built into the new library. Four terminals were installed at the Wilmington campus in 1983, and two were located at the newly established Terry Campus in 1985. PLATO lessons are now used in forty-five DTCC courses.

In addition to using PLATO courseware, faculty members in the Parallel Program have begun to develop their own lessons. Figure 168 shows part of a lesson that deals with sociology as a science. Students are given a theory for which they must write testable hypotheses and design a survey to test the hypotheses.

The Parallel Program's Department of Philosophy has developed a lesson that teaches categorical syllogisms in a logic course. Figure 169 shows how students are introduced to the concept of categorical syllogisms.

In 1986, the Associate Provost for Instruction released a PLATO version of the Transfer of Credit Matrix, which shows how credits are transferred among Delaware's institutions of higher learning.

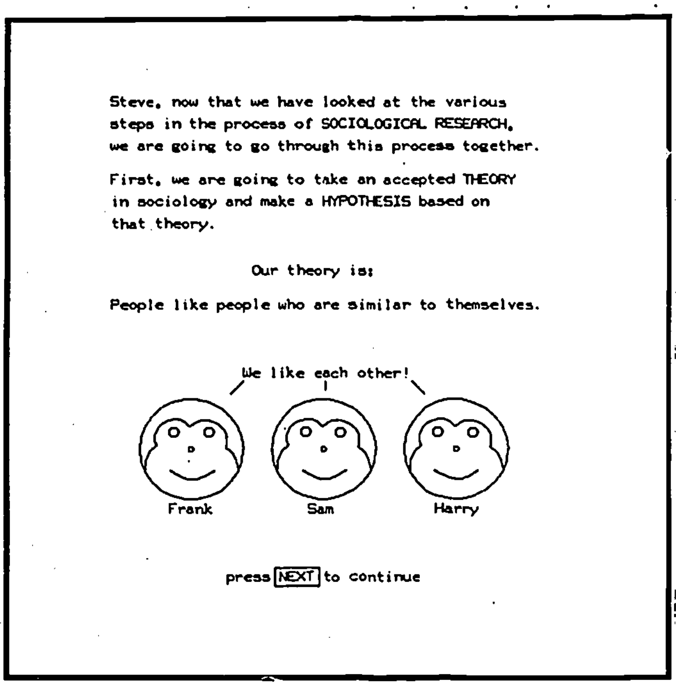


Figure 168. "Sociology as a Science-Module 1," by Henry Nyce and Stephen Guerke. Copyright© 1981, 1982 by the University of Delaware.

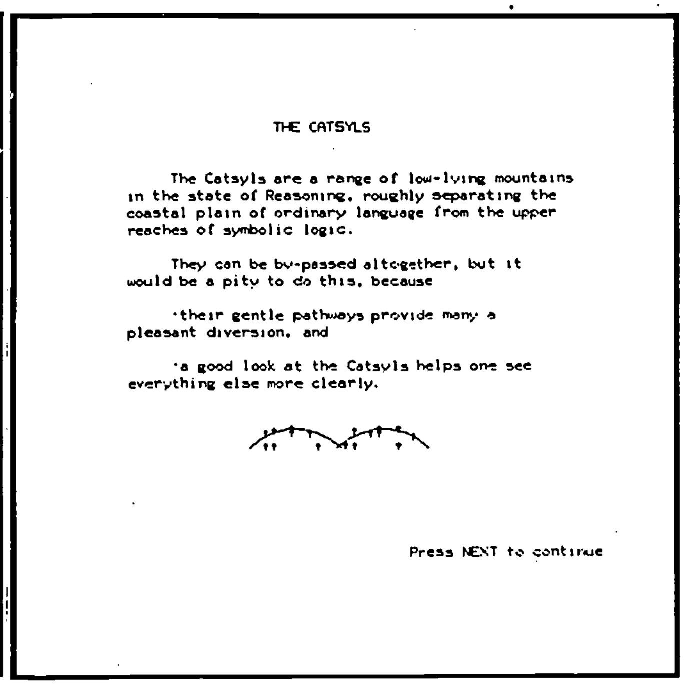


Figure 169. "A Holiday in the Catsyls," by Joan West. Copyright© 1981, 1982 by the University of Delaware.

Utilities

Since the beginning of OCBI, staff members have written software programs that are independent of specific academic disciplines and are in some cases not directly instructional in nature, but provide a valuable service to University students, faculty, or staff. Seven such lessons, called utilities, are described here.

The first utility has been very helpful both to faculty and students who are new to the PLATO system. Entitled "How to Use PLATO," it offers an interactive introduction to many features of the PLATO system, including the touch panel and the special function keys on the terminal keyset. Faculty members may select which sections of the lesson are appropriate for the students in their courses. A language professor, for example, would be interested in teaching students how to specify vowel and consonant markings in their responses, while a professor of mathematics would want students to learn how to type complex numerical expressions. Figure 170 shows a sample display from the lesson in which students are taught how to use the DATA and LAB special function keys.

The second utility is the "Questionnaire System," which allows easy entry of survey items in both multiple-choice and open-ended formats. Questionnaires constructed and administered on the PLATO system typically ask students to evaluate specific instructional lessons or the appropriateness of incorporating lessons into course syllabi. Figure 171 shows how a student responds to an open-ended question that asks what was liked about using the PLATO system.

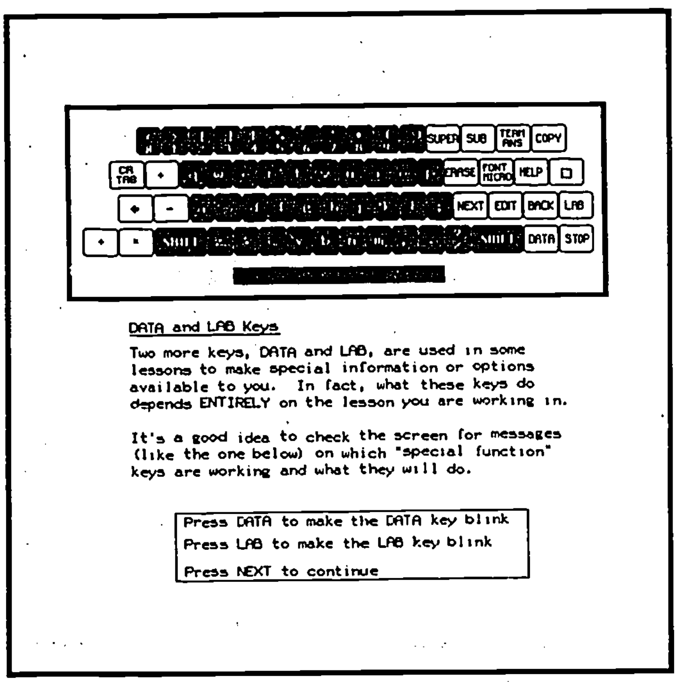


Figure 170. "How to Use PLATO," by Jessica R. Weissman. Copyright© 1976, 1977, 1979 by the University of Delaware.

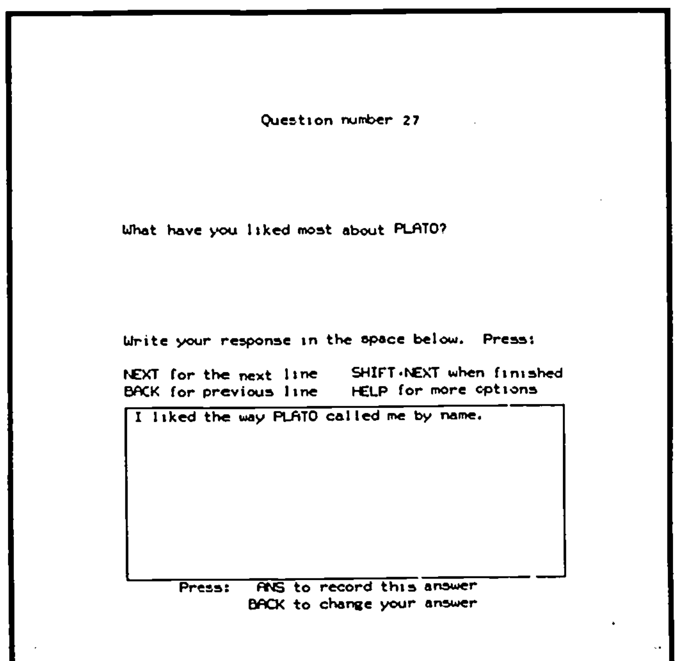


Figure 171. "PLATO Users Question Survey Package," by Daniel Tripp and Bonnie A. Seiler. Copyright© 1978, 1979, 1980 by the University of Delaware.

After administering a questionnaire, a faculty member can look at all responses to open-ended questions and at summary data on multiple-choice questions. Summary data includes for each question the total number of responses, the mean response, the standard deviation, the number of times each response was given, and the percentage of the total number of question responses represented by the number of times each response was given.

The third utility is a set of lessons developed at the University and used extensively by students, faculty, and staff. Entitled "The Lesson Catalog System," these lessons allow PLATO users to create, maintain, and use lesson catalogs. Each catalog can be a simple index of lessons or may contain a major index with several subindices, and multi-page descriptions of each lesson may also be included. These lessons provide the capability to format and print an off-line catalog as well. When a catalog is set up as a router for students, a menu of lesson choices from which students may freely choose is available, and a record is kept of student progress.

More than fifty catalogs that group lessons by subject matter have been compiled on the PLATO system to aid users in locating lessons they would like to use. Figure 172 shows the first page of a catalog that consists of lessons developed at the University of Delaware. This catalog has been divided into several subindices called categories that make it easy to find lessons in a particular academic discipline. If users choose option "a," accounting lessons, they will be taken to an appropriate subindex where they may choose a particular accounting lesson.

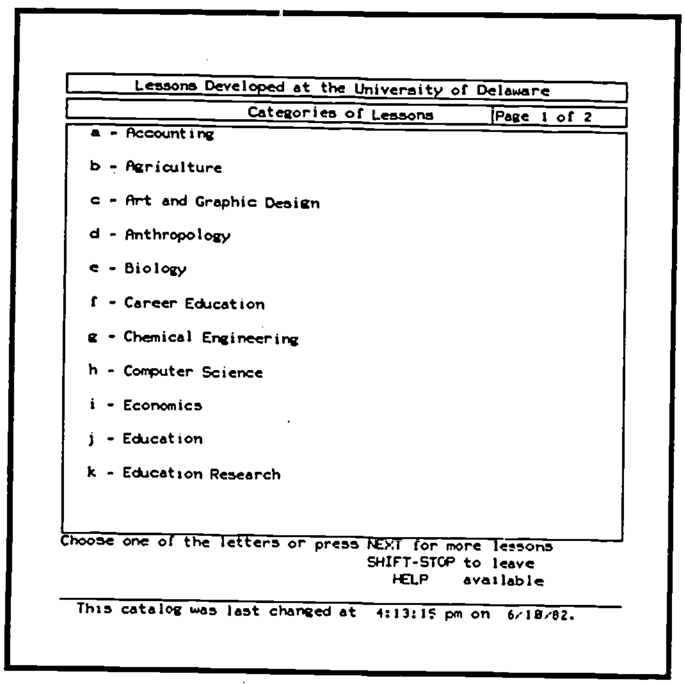


Figure 172. "Lesson Catalog System," by David G. Anderer. Copyright© 1978, 1979, 1980, 1981 by the University of Delaware.

The fourth utility is called "Classroom Scheduler System" and is a set of programs used by OCBI staff to coordinate group and individual reservations for terminals in the three major PLATO classrooms. These lessons help classroom site directors allocate terminal resources efficiently and ensure that a classroom is never over-booked. Several informative displays are available, including a daily schedule of reserved terminals, a list of available terminals, and a weekly schedule of classroom assistants.

A related fifth set of utilities collects data on the number of terminals used each hour at each PLATO site and the amount of computer memory used during that hour. This information is used in making decisions on placing terminals where they can be used most effectively and in optimizing scheduling arrangements. Figure 173 shows a sample display of terminals used, memory used (in thousands of computer words), and percentage use of computer resources on one day. This set of lessons interfaces with the classroom scheduling lessons to facilitate comparisons of scheduled and actual usage.

The sixth utility was developed for office use to allow part-time employees to record hours worked, broken down by work activity. At the end of each pay period, payroll report forms are printed and submitted to the University payroll office. The program keeps a record of hours and funds allocated to part-time employees, the total amount claimed from each authorized project account, and the work history for each pay period. Figure 174 shows information for a fictitious employee.

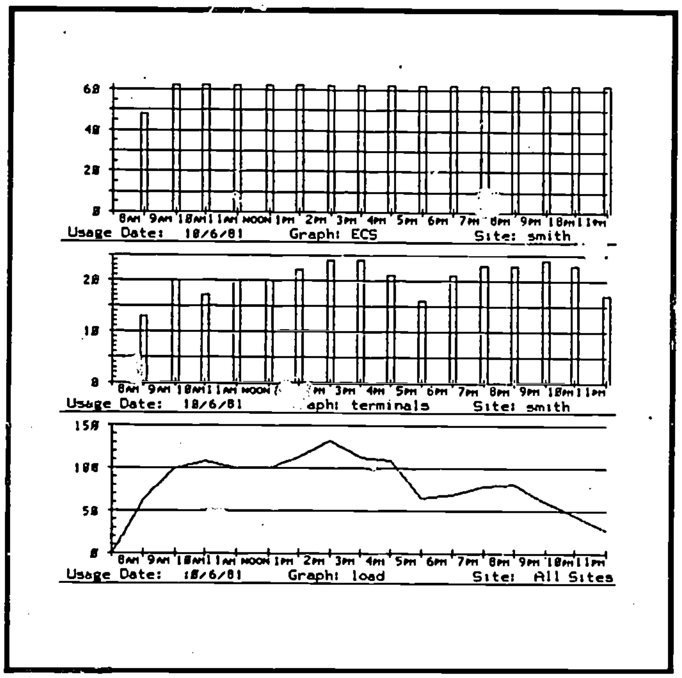


Figure 173. "UD Usage Summaries," by James H. Wilson. Copyright© 1978, 1979 by the University of Delaware.

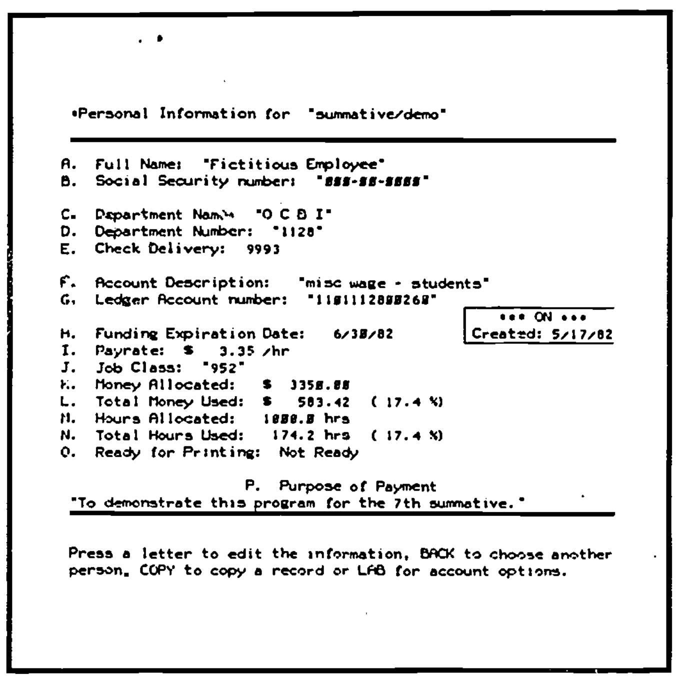
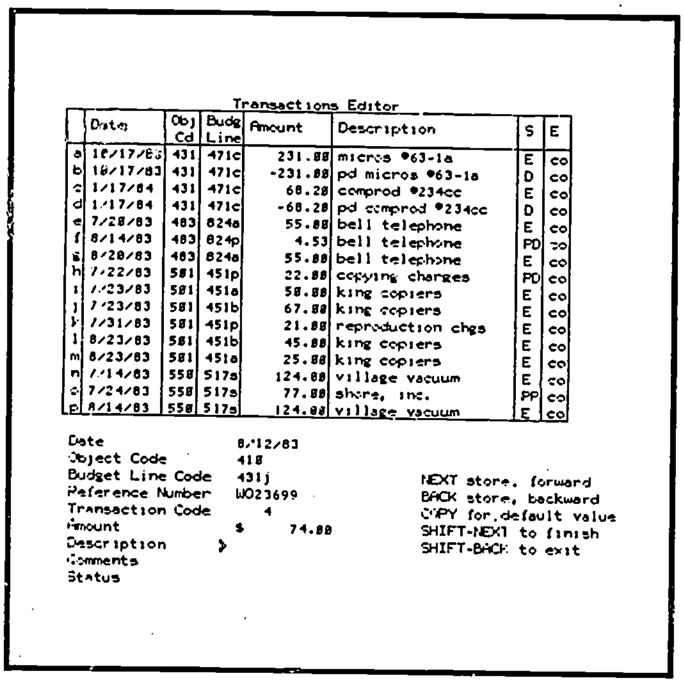


Figure 174. "Time Reporting Forms," by Michael Porter. Copyright© 1980, 1981, 1982, 1983 by the University of Delaware.

The seventh utility was also developed for office use to allow administrators to prepare current and revised budgets in a detailed format reflecting office purchasing patterns, to enter and track financial transactions, and to project total fiscal year expenditures based on year-to-date expenses and commitments. Figure 175 shows a new transaction that a manager is adding.

Several other utilities have been developed including a diagnostic test question driver, an equipment inventory, an appointment reminder, editors for memos and other short documents, and lessons that record the maintenance history of all CBI equipment.



Transactions Editor

	Date	Obj Cd	Budg Line	Amount	Description	S	E
a	10/17/83	431	471c	231.00	micros #63-1a	E	co
b	10/17/83	431	471c	-231.00	pd micros #63-1a	D	co
c	1/17/84	431	471c	68.20	comprod #234cc	E	co
d	1/17/84	431	471c	-68.20	pd comprod #234cc	D	co
e	7/28/83	403	824a	55.00	bell telephone	E	co
f	8/14/83	403	824p	4.53	bell telephone	PD	co
g	8/20/83	403	824a	55.00	bell telephone	E	co
h	7/22/83	501	451p	22.00	copying charges	PD	co
i	7/23/83	501	451a	50.00	king copiers	E	co
j	7/23/83	501	451b	67.00	king copiers	E	co
k	7/31/83	501	451p	21.00	reproduction chgs	E	co
l	8/23/83	501	451b	45.00	king copiers	E	co
m	8/23/83	501	451a	25.00	king copiers	E	co
n	7/14/83	558	517s	124.00	village vacuum	E	co
o	7/24/83	558	517s	77.00	shore, inc.	PP	co
p	8/14/83	550	517s	124.00	village vacuum	E	co

Date 8/12/83
Object Code 410
Budget Line Code 431j
Reference Number W023699
Transaction Code 4
Amount $ 74.00
Description >
Comments
Status

NEXT store, forward
BACK store, backward
COPY for default value
SHIFT-NEXT to finish
SHIFT-BACK to exit

Figure 175. "Budget Management Package," by Amy Sundermier, Bonnie A. Seiler, and Sharon Correll. Copyright© 1982, 1983, 1984 by the University of Delaware.

IBM PC Utility Lessons

Since 1983, OCBI's IBM team has been creating utility programs that reduce by as much as one-third the time needed to write lessons in Pascal. Two utilities have been completed so far, namely, a Graphics Editor and a Character Set Editor.

The Graphics Editor lets the user intermingle text and graphics on a high resolution, eighty-column, black-and-white screen, or on a low resolution, forty-column, color screen. Graphics functions include lines, arcs, circles, boxes, and ellipses. Users can fill any closed area with one of five predetermined patterns, or they can make their own patterns. Text can be placed at any pixel location and can be sized, rotated, superscripted, subscripted, emphasized, and edited. The text color can be changed at any time, as well as the character spacing. Moving and deleting objects is a simple task. Figure 176 shows a sample title page created with the Graphics Editor.

The Character Set Editor is used to create special fonts and special characters. There is no practical limit to the number of fonts or special characters that can be made. Once designed, they can be used just like regular text in the Graphics Editor. Figure 177 shows some special characters designed for use in the IBM PC version of a PLATO lesson. Once a display has been created, it can be saved on disk. Text and graphics are automatically translated into IBM Pascal code. No knowledge of Pascal is required to use the editors.

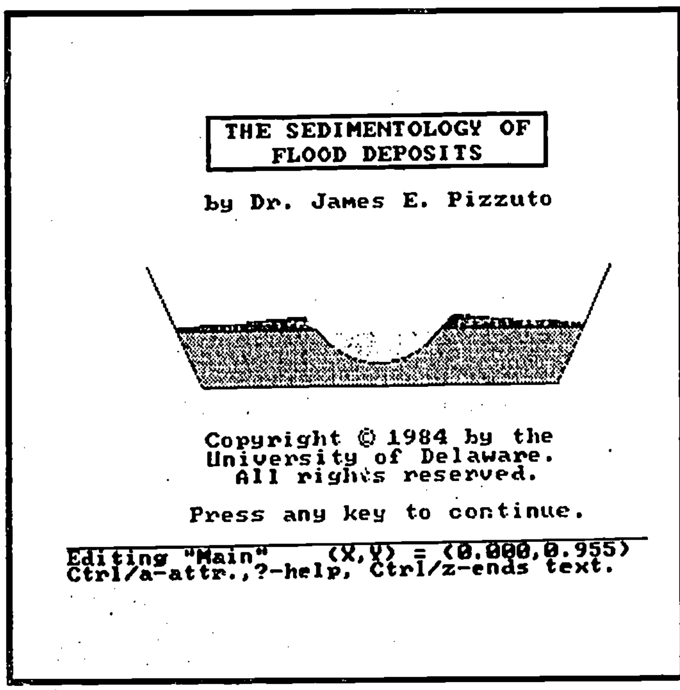


Figure 176. "Graphics Editor," by G. Reed, A. Sundermier, C. Green, P. Ballman, D. DiZio, P. Zographon, and L. Frank. Copyright© 1985 by the University of Delaware.

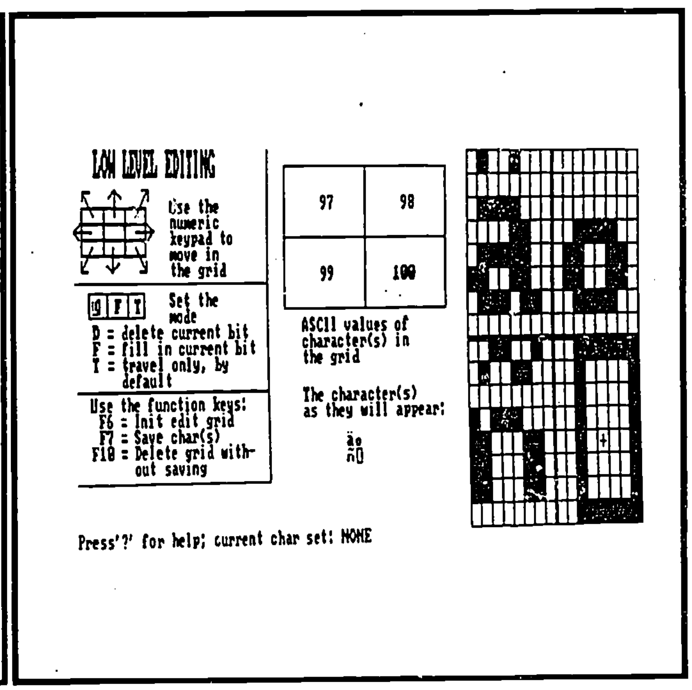


Figure 177. "Character Set Editor," by John Milbury-Steen and Louisa Frank. Copyright© 1985 by the University of Delaware.

Water Resources

The Agricultural Engineering Project has developed a computer-based information program called "Stormwater Management Alternatives--A Computer-Based Program for the Selection of Techniques to Mitigate the Impacts of Urban Stormwater." Implemented on the IBM PC, this program allows the user to describe a site and the nature of its proposed development. The computer calculates the additional volume of stormwater runoff that the proposed development will generate. Figure 178 shows the runoff for a typical site. The program then offers the user a list of potentially useful measures that would address the stormwater runoff problem and rates their effectiveness.

The stormwater management program functions as a technology transfer tool, affording users the opportunity to explore alternatives by providing information on the possible impacts of proposed land development plans, mitigation principles, and suitable practices. Potential users of the information base include public planning commissions, engineering consulting firms, colleges, universities, and public libraries.

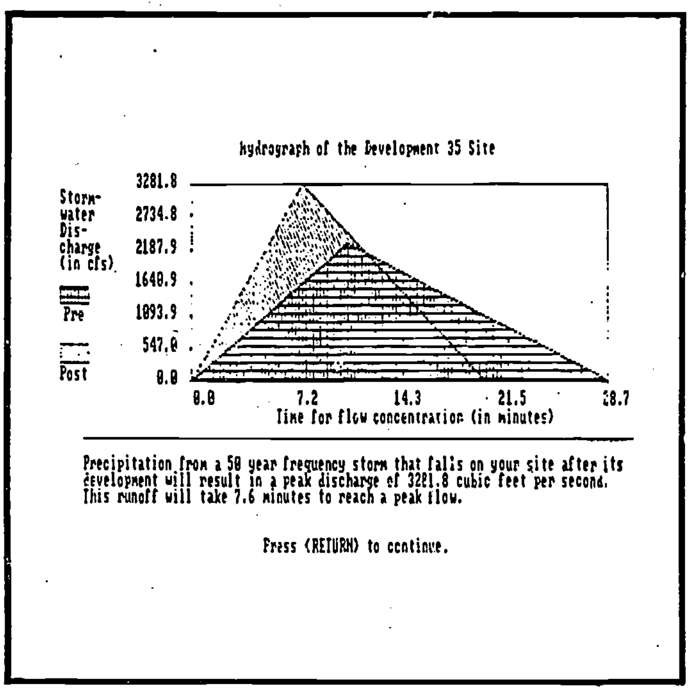


Figure 178. "Stormwater Management Alternatives," by T. Toby Tourbier and John Milbury-Steen. Copyright© 1984 by the University of Delaware.

Wellspring Health Education Project

The health education project officially began in November of 1979 by sponsoring a notesfile called "Sexednotes" in which students discuss sexually-related questions. Specially trained sex-education peer educators read and respond to these notes on a regular basis. A multiple sign-on allows easy student access to "Sexednotes." "Sexednotes" was so successful that two notesfiles were added in 1980. "Sexual Offense Notes" is monitored by S.O.S. members of the campus rape crisis group, and "Interpersonal Relations Notes" is checked by peer educators. In 1981, two more notesfiles were added; student clinical dietitians oversee "Nutrition Notes," and an alcohol educator monitors "Alcohol Abuse Notes." Student use and demand necessitated the addition of three more files in 1984; "Stress Management" is monitored by professionals on campus, "Fitness Notes" is checked by trained peer fitness educators, and "Eating Disorder Notes" is under the supervision of professionals and peer educators.

All eight of the Wellspring notesfiles allow students to write notes anonymously, a feature that contributes greatly to their widespread use. In addition to notesfiles, a number of lessons are available from the student/sexed sign-on, some from published courseware libraries and others developed by the health education project as shown in figures 179 and 180.

The health education project has also completed a lengthy series of lessons on contraception; student comments have been collected to help perfect the lessons.

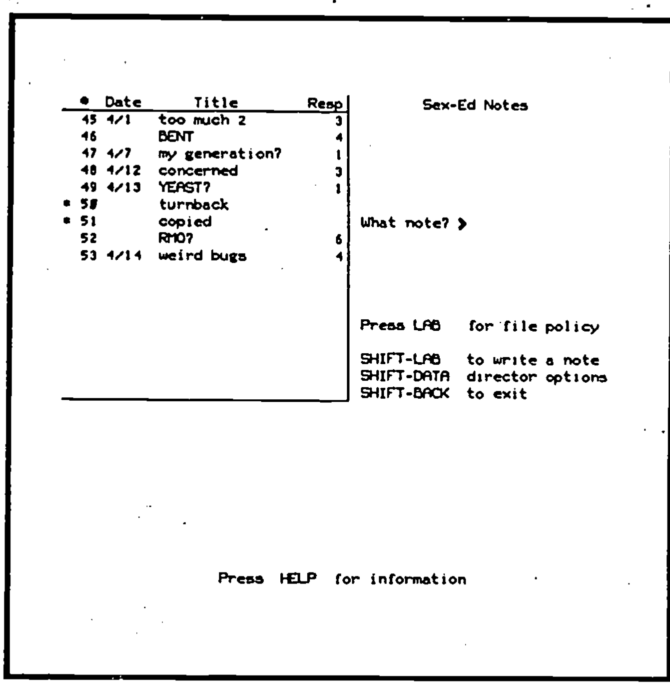


Figure 179. "Sex Education Notes," by Anne Lomax and the Sex Education Peer Educators. Copyright© 1980 by the University of Delaware.

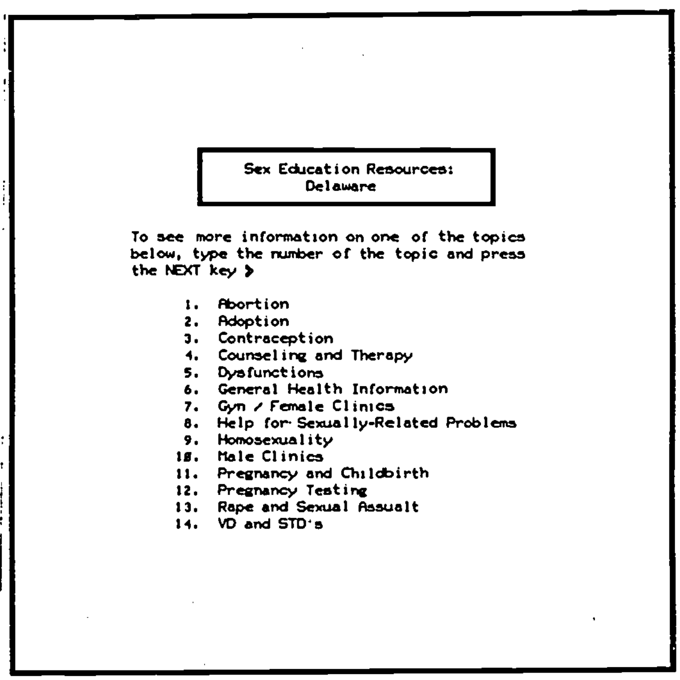


Figure 180. "Sex Education Resource Network," by Anne Lomax, Mark Laubach, and Daniel Tripp. Copyright© 1980, 1982, 1983 by the University of Delaware.

The index and a sample screen display are shown in figures 181 and 182. Each lesson includes information on general pointers, methodology, effectiveness, advantages, disadvantages, and reversibility. Another lesson in the series, "Contraception: Choosing a Method That's Best for You," provides the user with information about the decision-making process involved in choosing a form of contraception.

A lesson on alcohol use and abuse is now under development. "Thinking About Drinking: A Compendium of Alcohol Information" provides factual information on alcohol and its effects on the human body.

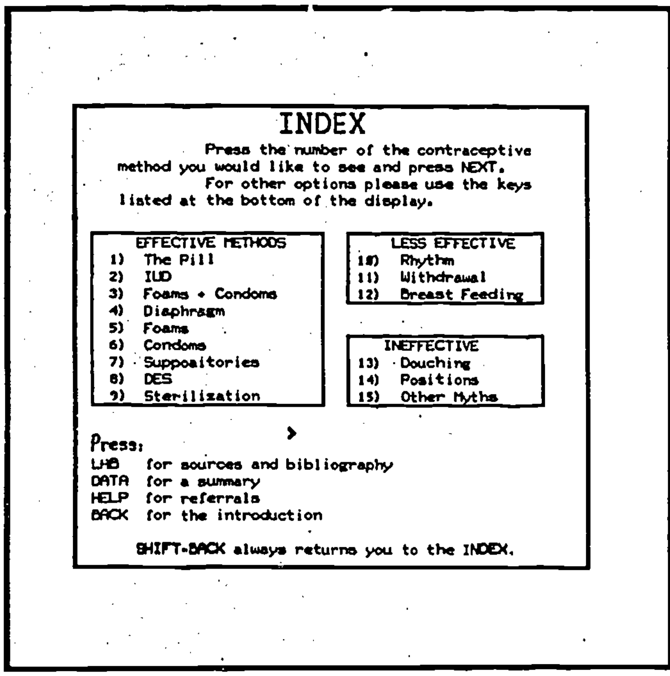


Figure 181. "Contraception," by Ivo Dominguez, Jr. and Anne Lomax. Copyright© 1980, 1982, 1983 by the University of Delaware.

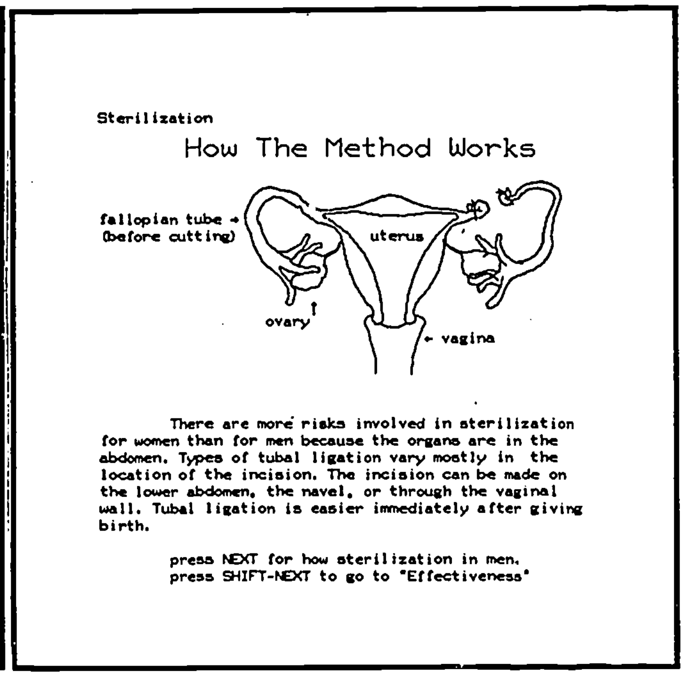


Figure 182. "Contraception," by Ivo Dominguez, Jr. and Anne Lomax. Copyright© 1980, 1982, 1983 by the University of Delaware.

CHAPTER III. OUTSIDE USER APPLICATIONS

In addition to supporting campus use, the Office of Computer-Based Instruction offers a variety of services to elementary and secondary schools, hospitals, government agencies, businesses, other universities, and nearby communities and community agencies. Services include the following:

- Subscriptions for computer services
- Workshops
- Consulting services
- Demonstrations
- Use of University classroom facilities
- Programming and design courses for junior and senior high school students
- Terminal loans

Detailed information about these services is contained in a brochure that can be obtained from a Customer Services Specialist by calling (302) 451-8161. Information about what some of the University's outside users have been doing with OCBI is reported in this section as follows.

Workshops and Consulting Services

Campus Visits

OCBI has provided on-campus consulting services to academic institutions and businesses from Denmark, Holland, Sweden, Great Britain, France, Italy, Taiwan, Mexico, South Africa, Australia, Israel, and Canada, as well as most states in the United States. In 1985-86, OCBI's services staff arranged sixteen site visits and consultation appointments.

CBE Lighthouse

In 1983, the Digital Equipment Corporation named the University of Delaware as its first CBE Lighthouse. CBE Lighthouses are a select group of colleges and universities that provide consulting services to Digital and its customers. During 1985-86, Digital sponsored site visits to the University for six academic institutions interested in exploring computer-based education.

Digital's other CBE Lighthouses include the University of Georgia, Indiana University, Iowa State University, and Taft College.

Independent Staff Consulting

OCBI staff members are experienced CBI professionals from a wide variety of backgrounds and are frequently consulted by other CBI users. This year, several staff members had consulting contracts to design and program CBI lessons and to teach workshops on programming, PLATO Learning Management, and lesson design. The companies and institutes served in 1985-86 are listed below.

University of Alberta
Edmonton, Alberta

Brigham Young University
Provo, Utah

C.I.N.E.C.A.
Bologna, Italy

EDUCOM
Princeton, New Jersey

E. I. Du Pont de Nemours & Company, Inc.
Wilmington, Delaware

Freed-Hardeman College
Henderson, Tennessee

H. B. Du Pont Middle School
Wilmington, Delaware

International Business Machines (IBM)
Boca Raton, Florida

Lawrence Public High School
Lawrence, Massachusetts

St. Elizabeth's High School
Wilmington, Delaware

St. John the Beloved Parish
Wilmington, Delaware

Westinghouse Electric Corporation
Pittsburgh, Pennsylvania

York College
Jamaica, New York

Pre-College Activities

Class Demonstrations and Public Use

During the 1985-86 academic year, teachers of more than 250 pre-college students arranged to have their groups visit the University in order to use OCBI computer classroooms. In addition to regular elementary and high school classes, students visited from science clubs, special education groups, gifted student programs, and nursery schools.

Many more students used the PLATO system on Saturdays, when the Willard Hall PLATO classroom is open to the general public (pre-college students must be accompanied by a parent). It was a common sight to see a parent and child sitting together in front of a terminal playing a math game.

New Castle County Vocational-Technical School District

The Howard Career Center's Academic Skills Center, under the direction of Ms. Vicki Gehrt, has been using the PLATO system since July of 1978. Because this program was so successful, Ms. Gehrt expanded it to include the Instructional Skills Lab at Delcastle Vocational School in September of 1980.

Students at both schools are using the Basic Skills Learning System as well as vocational lessons such as the package "How to Select and Get a Job." Figure 183 shows how the package teaches students to fill out a job application and asks them to identify mistakes made on the application. In addition, gifted and talented students are using PLATO lessons for educational enrichment and exploration. Figure 184 shows a display from a lesson in the Basic Skills Learning System mathematics curriculum, in which students are able to proceed at their own pace.

Pre-College Programming Courses

For the past ten years, summer programming courses have been held for high school students. During these four-week courses, each student plans and programs a lesson in an area of personal interest. Lessons have covered such topics as algebraic equations, units of measurement, and music. Several games have been written, as well as a test grade averager.

An advanced course has also begun for students who work on projects under the supervision of OCBI consultants.

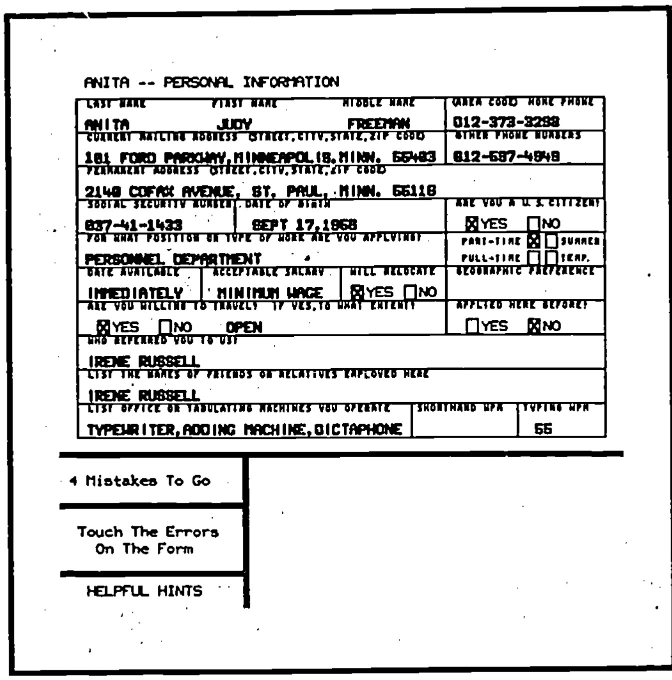


Figure 183. "How to Select and Get a Job," by James Vetsch, Karen Newhams, Kenneth Burkhardt, et al. Copyright©1978 by the Control Data Corporation.

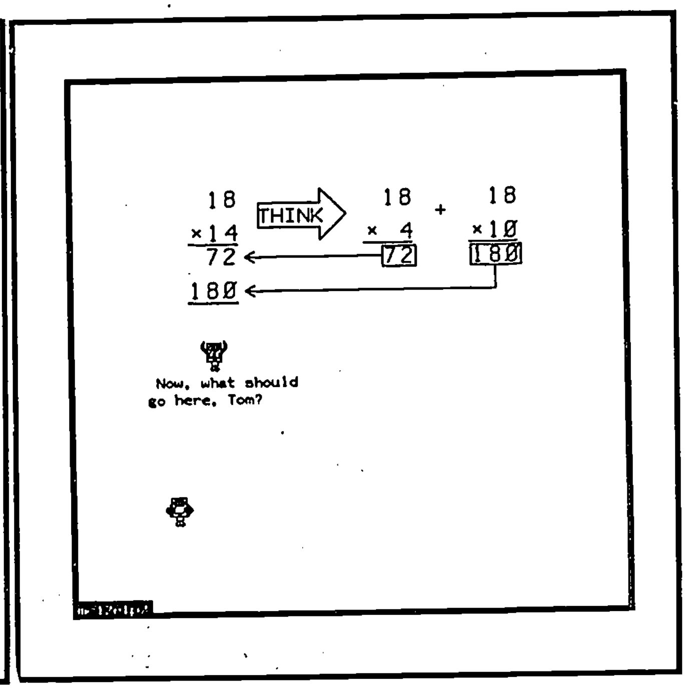


Figure 184. "Basic Skills Learning System: Multiplication Skills, Part 7, Cluster 12, Tutorial," by Ralph Heimer. Copyright© 1978, 1979 by the Control Data Corporation.

Saturday Morning Math Program

The Saturday Morning Math Program continued to be offered during 1985-86 to students in grades five through eight. Sponsored by the Mathematical Sciences Teaching and Learning Center, the program permits students to work on a variety of math materials and makes significant use of the University's educational computing facilities.

Emphasis is placed on sharpening problem-solving skills and helping students enjoy mathematics. Students engage in both individual and group activities. Individual work corresponds to each student's current level of skill in whole numbers, fractions, decimals, percents, beginning algebra, and word problems. Group activities afford students the opportunity to share and compare problem-solving strategies.

The program is supervised by a steering committee consisting of Dr. Ronald H. Wenger, Director of the Mathematical Sciences Teaching and Learning Center; Dr. William B. Moody, Professor of Mathematics and Education; and Dr. James Hiebert, Assistant Professor of Educational Development. The program provides an opportunity for mathematics education students to gain practical experience in using technology for instruction.

Saturday Morning Music Program

The Saturday Morning Music Program provides low-cost music instruction to the public. Sponsored by the Department of Music, all teaching is done by university music students. Saturday Morning Music uses the PLATO classroom located in the music building. Both children and adults use this facility.

Upward Bound

Since the summer of 1980, the University's Upward Bound Program has made individualized instruction via the PLATO system a regular part of its concentrated on-campus program for academically promising urban high school students, who use terminals on campus to study lessons in mathematics, English, science, and career counseling.

The objectives of the Upward Bound PLATO project include the following:

- Exposure to computers as a learning tool
- Extensive individualized instruction via the PLATO system
- Orientation and training of Upward Bound teacher aides in the capabilities of computers for instruction, record keeping, and motivation

During the summer of 1985, the Upward Bound Program initiated a computer literacy program in OCBI's Apple Classroom. Throughout the six week program, eighty participants used an Apple II for three hours a week, learning general computer literacy concepts and word processing. Pretesting and posttesting showed that the majority of students improved their computer literacy.

Community and Public Service

Mary Campbell Center Project

In 1982, as a public service of the University, OCBI worked with instructors from the University's Writing Center to place a PLATO terminal in the Mary Campbell Center, a residential facility for multiply handicapped adults.

The Mary Campbell project seeks to accomplish the following objectives:

- Make computer-based instruction available to the multiply handicapped
- Bring PLATO to students who would have great difficulty in coming to the University
- Increase the skills of the handicapped
- Enable handicapped students to work toward the GED (General Education Degree)
- Decrease cultural isolation of the handicapped by increasing their computer skills

All residents have been tested for motor and cognitive skills and use appropriate materials from a computer-based instructional curriculum covering four levels of competency. At some levels, the resident may play an instructional game upon completion of a basic skills math or reading assignment. Two residents became so confident using the terminal that they volunteered to assist other residents. One resident earned the final credits needed to complete his GED program.

In 1984-85 the Mary Campbell Center Project was expanded to include micro-computers. The Center purchased an Apple IIe, an Atari 800XL, and a CONRAC large screen monitor, which is invaluable to residents with visual impairment. IBM donated two PCs, two PCjrs, two graphic printers, two speech attachments, some software packages, and the support of interns sent to install and demonstrate the equipment.

Emphasizing the importance placed on this project by the residents and staff of the Mary Campbell Center and its supporters are further contributions of an Apple III computer system, a laser disc player, and numerous software packages.

Several proposals are pending. One would provide software to link the computers with the laser discs; another would allocate state funds for a full-time computer assistant position. These projects and the acquisition of more software, including the GED and math packages on PLATO, will contribute toward the goal of eventually providing credit courses via computer in the Mary Campbell Center.

Newark Free Library

In July of 1983, under a grant from OCBI, the Newark Free Library installed its first PLATO terminal, which serves two purposes: (1) to provide computer-based educational service to the community, and (2) to support a faculty research project.

To use the computer, patrons can seek help from printed and electronic instructions or from library staff trained by OCBI consultants. Reservations must be made in person for a one-hour session; non-scheduled time is available on a first-come, first-served basis.

Dr. James L. Morrison of the College of Human Resources has collected data on terminal usage from the PLATO network and from a written questionnaire. Data collected over the last three years shows exceptionally heavy use by students and children between the ages of four and eighteen, most of whom have no problems using the computer terminal. The project clearly demonstrates the popularity of PLATO as a community learning tool and may be considered an important dimension to the services provided by today's public library.

The installation of PLATO in the library initiated a great deal of newspaper and radio publicity and has furthered a symbiotic relationship between the University and the community.

Wilmington Community Centers

In 1980, the University of Delaware placed PLATO terminals in three of the ten Urban Coalition Community Centers in Wilmington. The Urban Coalition offers services such as basic skills instruction, job placement and counseling, access to academic PLATO program libraries, and access to the General Educational Development Learning System to minorities and people of all ages.

The Urban Coalition obtained from the U. S. Department of Education out-of-school basic skills funding which enabled two additional PLATO terminals to be placed in two more centers. The coalition continues to seek funds to expand its PLATO project.

PLATO Subscription Customers

Du Pont Biomedical Products Department

Located in the Quillen Building at Concord Plaza, the Du Pont Biomedical Products Department is using PLATO for in-house and external customer training for the Automatic Clinical Analyzer (ACA). Records on trainees are stored and analyzed. PLATO is used to generate trainee evaluation reports. The Department also uses PLATO to write lessons in micro-TUTOR for off-line delivery.

Du Pont Engineering Design Division

The Process Control Computer Group of the Engineering Design Division worked with OCBI to put its software standards on-line. The Process Control Group develops software that drives a large number of process control computers located in Du Pont and non-Du Pont plants. It has a high turnover of programmers and a strong need for standardization of coding practices. At present, it relies on one of the heads of the group and on a printed manual to teach software standards. By putting the software standards on the PLATO system, the group hopes to meet three goals: (1) teach the standards in a more uniform and effective manner; (2) update the standards easily, since they will be on-line; and (3) free the time of the employee that is currently doing the bulk of the teaching.

The Design Division Training Committee has completed its work with OCBI in adapting the Project System HOW reference manual to be used on the PLATO system. This manual introduces new employees to Project System procedures and is used to update veteran employees. Because the manual is revised frequently, the PLATO program is designed to allow Du Pont employees to enter content changes.

The Design Division has also completed a one-hour lesson with OCBI to introduce the Process Piping Evaluation Program (PROPEP) to new employees as well as to update veteran employees. PROPEP is designed to determine pressures, flows, and temperatures for liquids, gases, and steam in piping networks. Because PROPEP is so extensive, the PLATO program was developed to provide a non-threatening and painless guide for the employee.

In addition, the Design Division worked with OCBI to develop a ninety-minute PLATO program on Pressure Relief Valves. Industry standards pertaining to pressure relief valves are continually undergoing revision. This program is designed to provide a convenient reference source to inform and update engineers and to train them in the skills required for relief valve installation.

<u>Du Pont Engineering Services Division</u>

The Occupational Environmental Control Group has completed work with OCBI in developing a one-hour introduction to its Fundamentals of Industrial Hygiene course. This overview is used both in plants around the country as preparation for the course and with students taking the Fundamentals course itself. Student opinions of the lesson are being used to evaluate the use of the PLATO system in industrial hygiene training.

<u>Du Pont Experimental Station</u>

The Du Pont Experimental Station has made the PLATO system an integral part of its Laboratory Technician Training Program. The PLATO system was chosen not only because of its innovative teaching qualities, but also for its PLATO Learning Management (PLM) capabilities. Forty-six PLATO terminals are used by the trainees in this program. PLM is used to manage and record trainee study and testing results. OCBI's consulting services are being used on an as-needed basis.

<u>Du Pont Personnel and Employee Relation Division</u>

The Personnel and Employee Relation Division of General Services uses two PLATO subscriptions at the Barley Mill and Nemours buildings in a variety of training programs for support staff. Of particular importance is the delivery of the "O.N.E. Program" (Orientation of New Employees). Future plans include delivery of lessons aimed at supervisory training.

Philadelphia Prisons

The Computer-Based Education Program at the Philadelphia Prisons uses seventeen PLATO terminals to deliver the Basic Skills and General Educational Development Learning Systems to approximately one hundred inmates per day. Nine terminals are located at the House of Correction--eight in the male division, and one in the female division. Eight terminals are located at Holmesburg.

Inmates desiring to enter the program must have a fourth-grade minimum reading ability and at least two months of incarceration remaining. Figure 185 shows the typical sequence a student follows after applying for admission to the program.

OCBI worked with the Philadelphia Prisons to develop a one-hour PLATO program on computer literacy that was completed in the spring of 1986. This program informs inmates about the developmental history of computers, computer terminology, peripherals, computer applications, computing languages, and careers in computing.

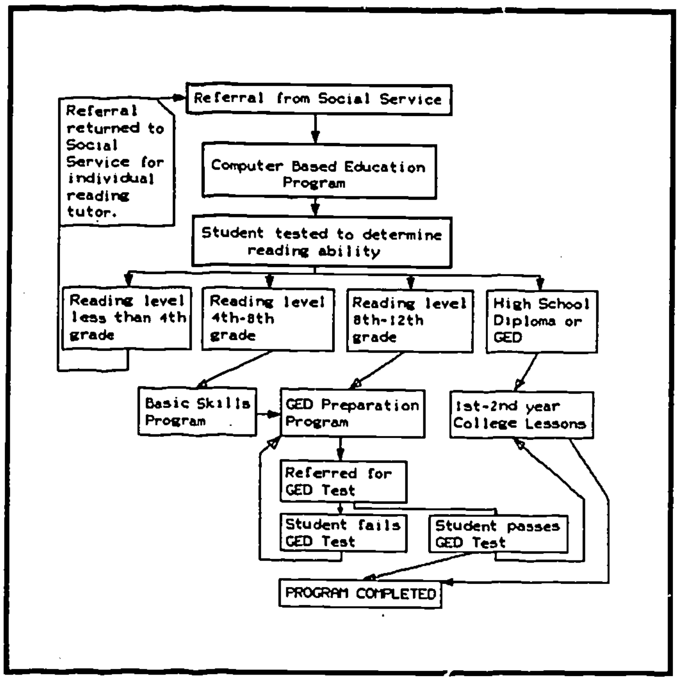


Figure 185. "Computer-Based Education Procedure Manual--Philadelphia Prisons," by Edward Szymanski. Copyright© 1982 by the City of Philadelphia.

Public Service Electric and Gas

The Public Service Electric and Gas Nuclear Training Center in Salem, New Jersey, is using four PLATO terminals and two Micro PLATO stations to provide computer-based instruction in nuclear plant operation. Figure 186 shows a typical lesson used by nuclear reactor operators to study power oscillation due to xenon poisoning.

Small Business Development Center

In September of 1982, John Stapleford, Director of the Bureau of Economic and Business Research, received a grant from the Small Business Administration to start the Small Business Development Center. The Office of Computer-Based Instruction was involved in this grant in two ways. First, PLATO training courses were offered to owners of small businesses, and second, seminars on how to use microcomputers as business tools were taught.

The PLATO courses covered management, sales, marketing, accounting, personnel, and computers. During the first five months of the program, one hundred clients using terminals in Newark, Wilmington, and Georgetown took these courses, which were offered free of charge under the grant.

OCBI also offered a seminar in how to use microcomputers as business tools. This seminar was presented five times in OCBI's Apple classroom. The cost to SBDC clients was minimal since part of the tuition was paid by the grant. Response to this seminar was extremely positive. One hundred four clients registered, and many others had to be turned away due to the lack of available seats. In September of 1983, 1984, and again in 1985, the Small Business Development Center grant was renewed, and OCBI continues to deliver the PLATO training courses.

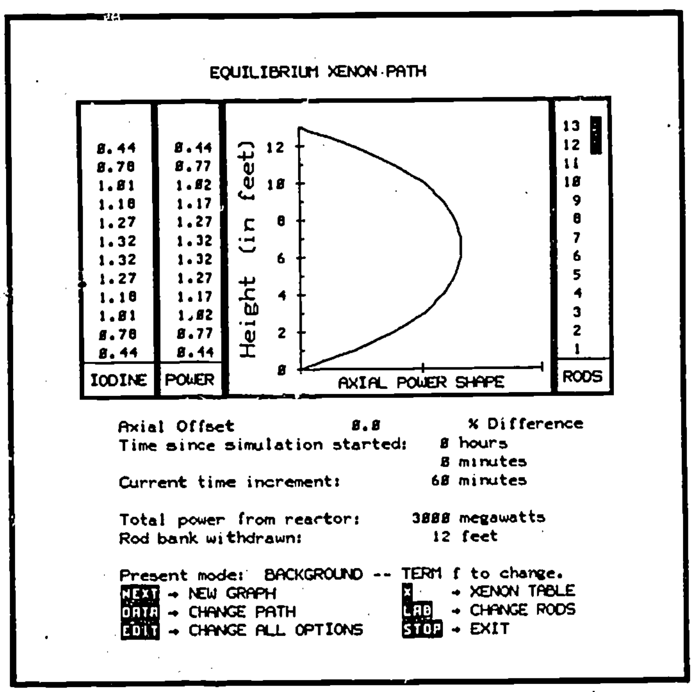


Figure 186. "Reactor Power Oscillation Due to Xenon Poisoning," by Richard Donofsky and Richard Hendrickson. Copyright© 1976 by Control Data Corporation.

York College

Faculty members at York College in Jamaica, New York are participating in a five-year Title III instructional technology grant. During the first year (1982), York College installed a PLATO terminal and a variety of microcomputers for the purpose of evaluating existing courseware. Included in this evaluation were lessons in accounting, education, English, ESL, music, physical education, and sociology. From 1983 to 1986, the Department of Education expanded the program, and York now operates classrooms full of Macintosh, IBM PC, and Apple IIe computers.

The University of Delaware conducts the semiannual external evaluations of this project.

Because of its developmental nature, the Office of Computer-Based Instruction regularly conducts a rigorous internal evaluation. Student opinions are highly valued and are collected in a systematic manner. Controlled experiments are conducted to test the effectiveness of new lesson materials. Project leaders prepare periodic project reports that are used in monitoring program development throughout the year, and a list of the principal values of computer-based instruction is maintained. The manner in which these components interact is explained below in the model for project evaluation.

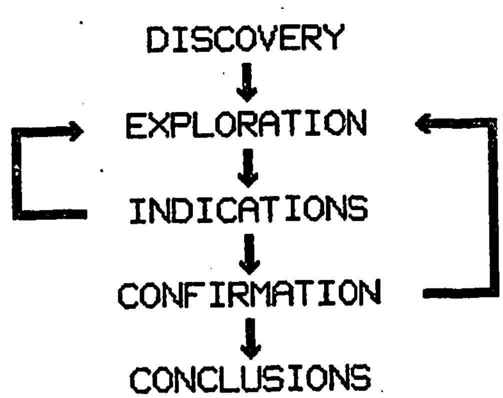
Model for Project Evaluation

At the College of Education's learning symposium on evaluation, Herbert J. Walberg maintained that the process of inquiry contains five main stages, namely, discovery, exploration, indications, confirmation, and conclusions. Every event in the history of computer-based instruction at the University of Delaware fits one of these categories, both at the overall Office level and within individual departments. At the Office level, PLATO was discovered by the Computer-Assisted Instruction Committee during the fall of 1974. The University explored the potential of PLATO during the trial period in the spring of 1975. Indications were summarized in the report of the summer of 1975. Confirmation that computer-based instruction has potential for the University was obtained during the 1975-76 and 1976-77 academic years, based on the successful implementation of PLATO in so many departments. The conclusion that computer-based instruction is a worthwhile long-term activity led to the installation of Delaware's own PLATO system in the spring of 1978.

Each department goes through these stages individually when it begins a CBE project. Discovery usually takes place at one of the periodic demonstrations or through the examples set by colleagues. Exploration consists of reviewing existing lessons, learning about the capabilities of various systems, and studying the results of published research. This phase is facilitated by the orientation seminar (see Instructor and Author Training), the lesson review process (see Orientation to Computer-Based Instructional Systems), and OCBI reference materials (see Organization). Indications are discussed and codified in meetings with peers, OCBI staff members, and departmental chairpersons. Confirmation is attained through repeated success of the program in its academic environment. Success is measured through student questionnaires and controlled studies of educational effectiveness. A continuous cycle of exploration, indications, and confirmation occurs, as shown in figure 187.

Figure 187.

Process of Inquiry in Departments Using Computer-Based Instruction



Student Questionnaires

An important component in the evaluation of OCBI is the opinion of the students. The instructor of every course that uses computer-based instruction is required to have students complete a questionnaire. Figure 188 shows a sample questionnaire. Instructors can administer the questionnaire as it stands, or they can change, delete, and add items peculiar to their courses.

Student response has been positive. Perhaps the two most important concerns are whether students enjoy computer-based instruction and whether they feel it is worth the effort. Nine out of ten students respond favorably in these categories.

Students request more flexibility in signing up for computer time, more workstations, and more programs. They ask that lessons developed at other universities be modified to use Delaware terminologies when different terms are used. Students want more exercises to practice in preparation for regular hourly exams. They ask that the computer be used for a greater percentage of their courses. Students applaud the computer's patience, stating how glad they are that the computer never gets tired of helping them. They like the way the computer shows them what they need to do to pass a course. The most frequent comment concerns the self-paced, individualized learning format. Students say the computer helps them most by providing individualized, immediate feedback to their answers.

SHORT RESPONSE FORM Figure 188

STUDENT EVALUATION OF PLATO ®

Course ____________ Instructor ____________ Date ____________

Please answer the following questions about your experiences with the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO. Thank you for your cooperation.

Indicate your degree of agreement with each of the following statements by marking:

A = Strongly Agree
B = Agree
C = Neutral
D = Disagree
E = Strongly Disagree

1. Using PLATO was an enjoyable learning experience.
2. The mechanics of using the PLATO terminal distracted me from learning.
3. The major points of the lesson were made clear.
4. The lessons on PLATO were too advanced for our level.
5. I learned what the lessons tried to teach.
6. I already knew the material covered in the lessons.
7. Most of the time the work on PLATO was too easy for me.
8. I was frequently frustrated while working on PLATO.
9. The lessons progressed too slowly.
10. The PLATO lessons were unnecessarily picky about the form of the correct answer.
11. The pace of the lessons was too fast.
12. PLATO is an efficient use of the student's time.
13. PLATO is well suited to presenting instructional material in this subject.
14. PLATO gives the student more feedback than other forms of instruction do.
15. The PLATO lessons helped me learn the material more thoroughly than with other forms of instruction.
16. The lessons made allowances for students with different levels of understanding.
17. A lesson on PLATO is more interesting than traditional instruction.
18. I found myself just trying to get through the material rather than trying to learn.
19. In view of the effort I put into it, I was satisfied with what I learned while using PLATO.
20. Too much class time was spent using PLATO.
21. I would like to spend more class time using PLATO.
22. I would like to take another course which uses PLATO.
23. I was able to schedule enough time each week in which to work.

PLEASE SEE OTHER SIDE.

INSTRUCTIONS

Use No. 2 pencil.
A correct mark should cover the complete outline.

1 A B C D E	8 A B C D E	15 A B C D E	22 A B C D E
2 A B C D E	9 A B C D E	16 A B C D E	23 A B C D E
3 A B C D E	10 A B C D E	17 A B C D E	24 A B C D E
4 A B C D E	11 A B C D E	18 A B C D E	25 A B C D E
5 A B C D E	12 A B C D E	19 A B C D E	26 A B C D E
6 A B C D E	13 A B C D E	20 A B C D E	27 A B C D E
7 A B C D E	14 A B C D E	21 A B C D E	28 A B C D E

IDENTIFICATION NUMBER

0 1 2 3 4 5 6 7 8 9 (9 rows)

E, D, C, B, A: 0 1 2 3 4 5 6 7 8 9

5, 4, 3, 2, 1: 0 1 2 3 4 5 6 7 8 9

Figure 188 (continued)

24. How many hours have you spent on PLATO in this course? (Mark your answer in the appropriate grid on the first side).

    (a) 2 or less (b) 3-5 (c) 6-10 (d) 11-15 (e) 16 or more

25. Have you used PLATO in any other courses? (Mark your answer in the appropriate grid on the first side).

    (a) Yes (b) No

26. Have you ever used a computer (other than PLATO) before? (Mark your answer in the appropriate grid on the first side).

    (a) Yes (b) No

    If so, in what ways is PLATO different from other computers? (Answer below).

27. What have you liked most about PLATO?

28. What have you liked least about PLATO?

29. What aspects of the PLATO classroom (acoustics, lighting, noise level, policies, staff, etc.) were distracting to learning?

30. What aspects of the PLATO classroom were helpful or conducive to learning?

31. What comments, criticism or suggestions do you have for making more effective use of PLATO in this course?

<u>Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe)</u>

An important addition to the research component of OCBI was the founding of the Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe) in 1980. CIRCLe, which is funded by OCBI, serves as a center within the College of Education and fulfills four primary functions:

1. to help faculty and staff with design and analysis in CBE research projects;
2. to establish an up-to-date database of CBE research materials;
3. to help promote the communication of CBE research ideas and techniques both within the University community and with other universities and research institutions; and
4. to assist in the writing of grant proposals in CBE research areas.

CIRCLe is governed by a board of directors consisting of two faculty members from the College of Education and three from other colleges. During 1985-86, the advisory board was constituted as follows:

Daniel L. Chester, Computer and Information Science
Gerald R. Culley, Languages and Literature
Sylvia Farnham-Diggory, Educational Studies
James E. Hoffman, Psychology
Fred T. Hofstetter, Music and Educational Studies, Chairperson
C. Julius Meisel, Educational Studies
Ronald H. Wenger, Director of the Mathematical Sciences Teaching and Learning Center

CIRCLe has provided assistance with research design and statistical analysis of CBE research data in languages, education, consumer economics, nursing, music, math, the Writing Center, counseling, and the library. The CIRCLe Reference Collection, which contains more than 1700 titles, has been reorganized, systematized, and expanded. An on-line catalog allows searches of research material by author name, title, or publisher. The search system includes those portions of the ERIC database that pertain to CBE research. A keyword and author search system has also been developed for the ERIC database.

In order to assist faculty and staff in writing grant proposals, CIRCLe has worked closely with the Office of Research and Patents, the Office of Contracts and Grants, and the Office of Research and Evaluation of the College of Education. Publications that list available project funds are reviewed periodically. Information gathered from these sources is available on-line.

The major event during CIRCLe's first year was a Research Retreat held at the Red Fox Inn in Toughkenamon, Pennsylvania, on February 9, 1981. In addition to papers by several University of Delaware faculty, Dr. Eric McWilliams of the National Science Foundation presented a paper on "Computer-Based Experimentation Into Computer-Based Problem Solving."

The year 1982 was highlighted by a major international conference on CBE research entitled "CBE Research: Past, Present, and Future." This conference, which was sponsored by the College of Education, was held at the Radisson Wilmington Hotel on June 3-4. Dr. Robert Glaser, director of the Learning and Research Development Center (LRDC) at the University of Pittsburgh, was the keynote speaker. Other invited speakers were Dr. John Sealy Brown from Xerox PARC, who spoke on Intelligent CAI (ICAI); Dr. Steve Hunka from the University of Alberta, who spoke on Evaluation and CAI; and Dr. Patricia Wright from the Medical Research Council in Cambridge, England, who spoke on Human Factors in Delivering CAI. Representatives from industry and the military demonstrated recent advances in ICAI hardware and software. In addition, several refereed papers were presented in the areas of evaluation and human factors. The conference was an attempt to sum up the state of the art in ICAI research and provide a stimulus for the encouragement of further research. Proceedings of this conference are available from CIRCLe.

The second biennial Research Retreat was held February 7, 1983, in Clayton Hall. Despite inclement weather, approximately one hundred faculty and staff attended. Professor Victor R. Martuza delivered the keynote address on modern techniques for exploratory data analysis. Other speakers included Professors C. Julius Meisel, George A. Smith, Michael A. Arenson, Ronald H. Wenger, James E. Hoffman, Gerald R. Culley, Clifford W. Sloyer, Sylvia Farnham-Diggory, William S. Bregar, and Fred T. Hofstetter. Dr. Carol J. Blumberg acted as discussant. Dr. Frank B. Murray, Dean of the College of Education, provided the closing remarks.

During the spring of 1983, Dr. William S. Bregar, visiting professor from Oregon State University, gave a series of colloquia for faculty and staff. These talks centered on Intelligent CAI, including his own work on an intelligent algebra tutor.

The third biennial Research Retreat was held at Clayton Hall on February 11, 1985. One hundred and fifty faculty and staff attended. Following Dean Frank B. Murray's welcoming remarks, Dr. Helen Gouldner, Dean of the College of Arts and Science, presented a provocative presentation entitled "Confessions of a Novice." Dr. Alan Lesgold, Director of the Learning and Research Development Center at the University of Pittsburgh, delivered the keynote address, "Beyond PLATO: The Next Steps in the Development of CAI." Other speakers included Suzanne McBride, Marion C. Hyson, Sandra K. Morris, Cynthia L. Paris, Sylvia Farnham-Diggory, Julie Schmidt, Marjorie Hoerl, Mark Brittingham, C. Julius Meisel, Ralph Ferretti, John L. Burmeister, Lynn H. Smith, Will Norman, Fred T. Hofstetter, Arthur Hoerl, Victor Martuza, John H. Schuenemeyer, Mary Jac Reed, David B. Brady, and Carol Joyce Blumberg. Provost L. Leon Campbell delivered a stimulating luncheon speech.

During 1984-85, Dr. Alan Lesgold was retained as a consultant to advise on the growing number of Delaware's ICAI projects. In 1983-84, projects dealing with reading, music, and LOGO had been funded under OCBI's annual RFP process, and in 1984-85, similar projects began in chemistry, mathematics, and Latin. Since all of these projects are being programmed in LISP, Dr. Lesgold recommended the acquisition of Xerox 1108 Artificial Intelligence Workstations, which are commonly known as "Dandelions." The Dandelions are housed in CIRCLe and run LISP interactively, just as home computers run BASIC. The Dandelions have high resolution displays with a grid of 1024 points across by 808 points down the screen. Figure 189 shows how built-in support for windows allows several parts of a program to be edited simultaneously.

Growing attendance and enthusiastic evaluations led to making the Research Retreat an annual event beginning in 1986. Dr. James A. Kulik from the Center for Research on Teaching and Learning at the University of Michigan was the featured speaker. His keynote address, "Classic CAI: What Difference Has It Made?," was followed by presentations on controlled evaluations of classic CAI programs by James L. Morrison, Paul H. Sammelwitz, Ronald H. Wenger, Michael A. Arenson, and Fred T. Hofstetter.

Following a luncheon talk by Provost L. Leon Campbell, James E. Hoffman began the afternoon with a presentation entitled "The Cognitive Science Revolution and Its Implications for Intelligent Computer-Assisted Instruction." A panel consisting of Daniel L. Chester, Gerald L. Culley, Sylvia Farnham-Diggory, and Ronald H. Wenger was chaired by Dr. Hofstetter and discussed how ICAI can improve traditional methods of computer education.

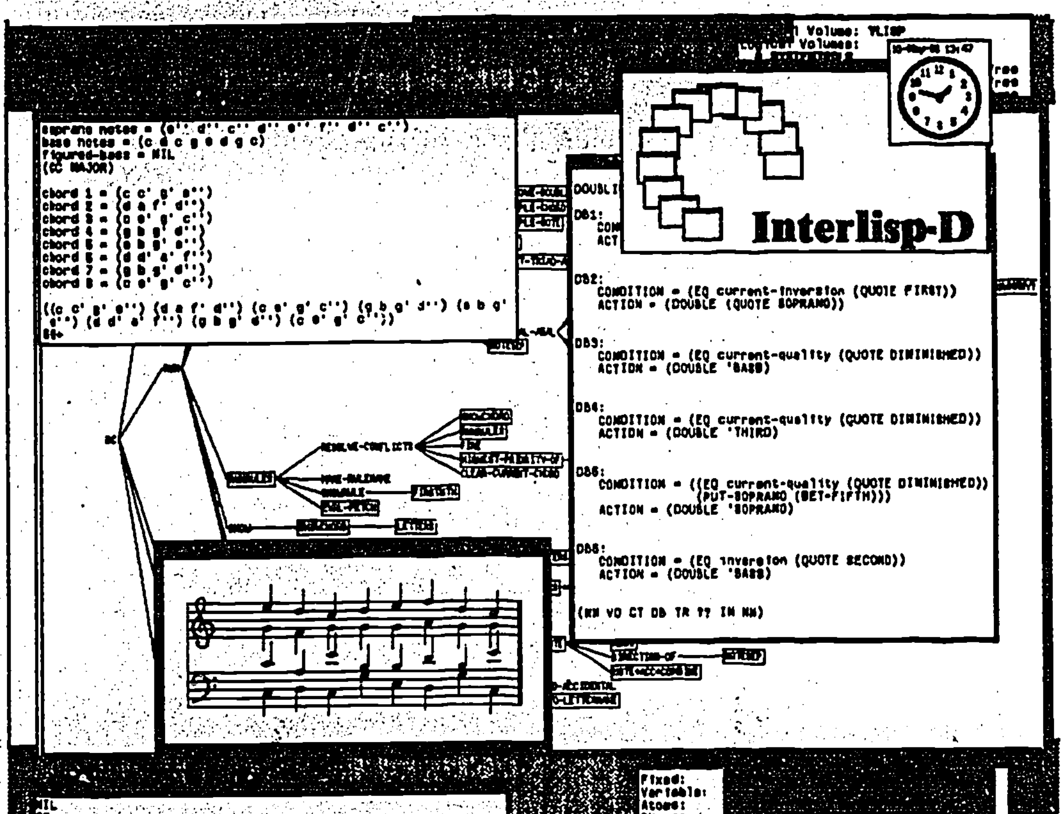


Figure 189. Windowing on the Xerox 1108 Artificial Intelligence Workstation.

The retreat concluded with presentations by Professors Michael Nesterak and George G. Bear on the use of computers by young people. Dr. Kulik provided a summary of and reacted to the day's events. Approximately 150 faculty and staff attended. Titles of the presentations are listed in table 8.

Throughout the year, CIRCLe has continued to support faculty and staff who are doing research in ICAI; it has also participated in the Mid-Atlantic Educational Computer Consortium (MAECC), a group of eleven land grant universities that are sharing ideas and resources in computer-based education.

To extend its outreach activities, CIRCLe assumed responsibility for coordinating the Summer Institute in Computer-Based Education (SICBE) in 1983. SICBE provides public school teachers and University faculty members with an intensive four-week program that consists of three two-hour courses. Table 12 lists the course descriptions. The first institute was held in the summer of 1976 and was funded by the Delaware School Auxiliary Association (DSAA), which played a key role in establishing the institute series. The second institute, held in 1977, was designed for science and mathematics teachers and was jointly funded by DSAA and the National Science Foundation (NSF). NSF funded the institutes from 1978 through 1981. In 1981, NSF funded a special administrator's institute in addition to the one for teachers.

In 1982, the institute focused on foreign language teaching and was funded by the National Endowment for the Humanities. The institute held in 1983 covered general topics, and the 1984 institute concentrated on language arts and humanities. In 1985, the summer institute once again focused on science and mathematics. SICBE attracts participants not only from Delaware, but also from other states and countries. Course descriptions can be found in table 12.

Table 12

Courses Offered During the Summer Institute in Computer-Based Education

EDS 513. Microcomputers in Education (2 credits). Survey of the applications of microcomputers to education including history, theory, economic and sociological implications. Covers the use of microcomputers in CAI delivery, as instructional tools, in teaching programming skills, and for acquiring computer literacy.

EDS 514. Educational Microcomputer Program Evaluation and Design (2 credits). Identification of instructional goals and their attainment through computer-based learning materials. Includes design for evaluating existing materials and for creating new courseware. Design of a small segment of Courseware will be required.

EDS 515. Educational Microcomputer Programming (2 credits). An introduction to instructional programming. Covers variables, repetition, selection, encoding, string processing, tables, matrices, graphics, functions, procedures, and the interactive use of joystick controllers and light pens. Taught in a computer classroom in which each participant is provided with a personal computer, the course is individualized so as to be appropriate for novices as well as those with previous programming experience.

EDS 533. Integrating CBE into the Curriculum (2 credits). Methods of integrating computers into school and classroom contexts with emphasis on implementation in the participant's curricular area.

EDS 534. Advanced CBI Instructional Design and Evaluation (2 credits). Continuation of EDS 514 with emphasis on the design of original materials. Includes techniques of formative and summative evaluation. Requires the scripting of an original design as a final project.

EDS 535. Advanced Computer-Based Programming (2 credits). Advanced structured programming techniques for educational microcomputing. Requires the programming of an original script as a final project.

Published Papers

To date, University of Delaware faculty and staff have published 90 papers dealing with computer-based education. Listed below are abstracts of papers published in 1985-86; Appendix C contains a list of studies completed in years past.

Balogh, Nancy and Carol Jarom. 1986. Operation of a Microcomputer Classroom Using a Network Application. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 120-122.

The operation of a microcomputer classroom can be considerably more versatile and better adapted to user needs when the computers are connected by means of a network application. A network provides each work station many of the advantages of a mainframe while preserving the versatility of a stand-alone microcomputer. The Office of Computer-Based Instruction at the University of Delaware operates two network microcomputer classrooms in the College of Engineering. This paper discusses attributes and the operation of these two networks.

Frank, Louisa. 1986. Developing CAI in Pascal. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 127-130.

There are many programming languages available for microcomputers. Each language has certain characteristics that, in most cases, are disadvantageous when used for computer aided instructional development. A CAI language should be well documented, appropriately used, and fully supported by the target machine. It should not limit the lesson design and should be fairly transportable.

Hofstetter, Fred T. 1986. Computers in the Curriculum: Music. Electronic Learning, Vol. 4, No. 8, May/June, pp. 45-47.

This article contains a summary of four programs commercially available for music composition on microcomputers. Discussed are "Songwriter," "Music Construction Set," "Musicland," and "Making Music on Micros: A Musical Approach to Computer Programming."

Hyde, Paul L., Deborah G. Mellor, Cynthia A. Parker, Catherine B. Phillips, and James H. Wilson. 1986. A Model for Supporting University CBI Products and Services. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 96-100.

One successful model for interaction between CBI development projects and people outside their institution involves a customer-service team specifically charged with the responsibility. Team members provide and coordinate services of the University of Delaware's Office of Computer-Based Instruction. The tasks included in these services are outlined, and estimates of the time necessary to accomplish them are provided.

Jarom, Carol and Paige Vinall. 1986. Tools for Developing a Geography Package in UCSD p-System. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 131-135.

As part of the University of Delaware's commitment to CBE, the Department of Geography and the Office of Computer-Based Instruction developed "Map Layout and Design," a package of exercises on the IBM Personal Computer. The purpose of this package is to improve instruction in cartographic design and map layout through computer-aided design methods. The creation of a map layout is normally a very tedious undertaking involving hours of drafting. However, this software package allows the student to create better maps in less time; a layout that would take ten hours by hand can be achieved in one to two hours on the IBM PC.

Lambrecht, Madeline E. 1985. Computer-Assisted Instruction: A Vehicle for Affective Learning. Instructional Computing in Nursing Education, October 11-12, pp. 133-139.

A review of the currently available nursing software shows that the majority of the programs are directed toward learning in the cognitive and psychomotor domains. As a profession, nursing promotes personal as well as professional growth, although personal growth is not reflected in the available software. One area of nursing that lends itself well to a full exploration of the affective realm is death and dying. Death and dying are experiences that all individuals, nurses included, have in common. It is appropriate that data collection begin with the self both as a basis for future nursing practice as well as for life itself. Computer-assisted instruction (CAI) can be instrumental in helping students achieve self-awareness related to the death experience. A CAI lesson entitled "Death: A Personal Encounter," was developed on the PLATO system at the University of Delaware. The purpose of the program is to focus attention of one's attitudes, beliefs and feelings as they relate to death in general and to one's own death in particular. The program is intended as an initial step in the self-awareness process. It is divided into two main parts: (1) a series related to death and dying, and (2) a simulation in which the student contracts a terminal illness and is actively engaged in the treatment process (if he or she so chooses) right up to the time of death. Personal data solicited in an early segment of the program allow for personalization of both feedback and graphics. This CAI program has been utilized by both undergraduate and graduate nursing students at the University of Delaware over a period of three years. Response to the program is measured by an on-line evaluation questionnaire that appears at the end of the lesson. The cumulative response has been highly favorable which indicates that further CAI program development in the area of affective learning has considerable merit.

Mayhew, Frances and David M. Johns. 1986. Field-Testing: The Refining Step. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 53-57.

Following completion of programming and internal review, an educational program is ready for evaluation in a classroom setting. Design weaknesses and programming problems that are not discovered through preliminary evaluation can be identified through field testing. This paper presents and discusses a structural model for the evaluation of computer-based instructional materials through field testing.

Paulanka, Betty J. 1986. A Study of Learner Traits and Learning Outcomes with Nursing Students and CAI. Proceedings of the 19th Annual Hawaii International Conference on System Sciences, January 10-12, pp. 33.

This descriptive study examined the personality traits and instructional time factors of successful and nonsuccessful students who utilized Computer-Assisted Instruction (CAI) to learn psychopharmacological nursing. Data from this study supports the contention that there is beginning evidence to imply that there are certain individual traits that can be used to predict successful learning with CAI. A stepwise multiple regression analysis identified seventeen variables that contributed to successful learning. Specific academic, cognitive, demographic and philosophical indicators emerged as the most consistent predictors of learning associated with these psychopharmacological lessons presented on the PLATO system. These results and others are explored in terms of educational implications and suggestions for future research which can be used to plan more effective and efficient use of computers in nursing education.

Reed, George. 1986. User Oriented Tools for CBI Development. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 101-104.

The Office of Computer-Based Instruction at the University of Delaware has produced an integrated set of authoring tools for the IBM PC. These tools are written in Pascal and provide an easy, user-friendly environment for the development of lessons. This environment provides many advantages over other common development methods. The development and use of such tool collections should be considered as a viable alternative to the use of complete authoring systems or educational authoring languages.

Reed, George and Nancy Balogh. 1986. Some Considerations Involved in the Installation of Ethernet Networks at the University of Delaware. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 148-150.

The availability of microcomputer networks creates new opportunities for innovative uses of computers in educational settings. Considerations of network costs, installation requirements, capabilities, and limitations are keys in choosing a network application, but some of these questions are more easily addressed than others. This paper will discuss the implementation of Ethernet networks by the Office of Computer-Based Instruction at the University of Delaware.

Reed, Mary Jac. 1986. Needs Analysis for a Computer-Based Statistics Course. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 105-107.

Under a grant from the Digital Equipment Corporation, the University of Delaware's Office of Computer-Based Instruction is developing a one-semester, computer-based statistics course. This paper provides details regarding the planning and design for the statistics package as an example of a needs analysis performed for a computer-based course.

Reed, Mary Jac. 1985. The Conversion of PLATO Courseware to the Digital Authoring Language. EDU Magazine, Digital Equipment Corporation, Fall, Vol. 39, pp. 11-13.

As a test of Digital Equipment Corporation's Courseware Authoring System (C.A.S.), the Office of Computer-Based Instruction (OCBI) at the University of Delaware converted five lessons from the Control Data PLATO System to Digital's C.A.S. in the VAX/VMS environment. Originally written in the TUTOR language, the lessons were translated into the Digital Authoring Language (DAL). The lessons use high resolution graphics, key-by-key processing, sophisticated judging, animation, and response-sensitive branching. Due to the similarities between the TUTOR and DAL languages, the conversions proceeded quite smoothly, and DAL proved to be an authoring language capable of supporting the broad range of educational applications demonstrated by the lessons.

Richards, Deborah. 1986. Developing a Library Skills Program for the IBM PC. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 144-147.

A package of four PLATO lessons was converted to run on the IBM Personal Computer with a monochrome display. To convert the lesson, a screen editor was developed that would allow non-programmers to create individual displays of a lesson, containing text and character graphics which would then be translated into Pascal code by the editor. After the individual displays were completed, sequencing and answer judging routines were added to create a final working version of the lesson. This paper reviews the conversion process and discusses the advantages of the approach used.

Sammelwitz, Paul H. 1985. Instructional Improvement: The Computer as a Creative Supplement. Proceedings of Computers in the Animal Science Classroom Workshop, sponsored by the North Central Computer Institute, Iowa State University, Ames, Iowa, October 21-23.

This paper details how CAI is used in a two-semester course in Anatomy and Physiology at the freshman and sophomore level. Evidence is cited which indicates the instructional value of traditional CAI in these courses and the added benefit of the instructor's willingness to invest the time required to make the communications option function. Utility lessons allow the students to keep track of their grades throughout the semester and enable the instructor to monitor the performance and work habits of individual students. Students are more willing to express themselves when communicating via computer than by a face-to-face discussion with the instructor. End-of-semester evaluations are positive in regard to the use of the notesfiles; it is felt by the instructor that the primary benefit of CAI has been the notesfile options.

Smith, Lynn and Roland Garton. 1986. Better Chemistry Through ICAI: Getting Started. Proceedings of the 27th International Conference of the Association for the Development of Computer-Based Instructional Systems, February 3-6, pp. 221-226.

After one year's work, the authors have developed an early version of an artificially intelligent lesson which drills and remediates chemistry students on Lewis structures. This paper describes what the early versions will accomplish, what steps have been taken, and what decisions were made to get the project to its current stage.

Overall Educational Value of Computer-Based Instruction for the University of Delaware

As the number of departments using computer-based instruction has increased from three in 1974 to forty-four in 1986, faculty and students have identified many benefits of CBE for the University of Delaware. It is through the realization of these benefits that CBE has received widespread support and acceptance at the University. This report concludes with the classification of these benefits according to eleven main purposes which are enumerated and explained as follows:

1. To individualize instruction. Faculty members and students often complain that the level of instruction is never right for all members in a class. Some are fast learners; others are slow learners. Some drop out because a course is too boring; others drop out because they cannot keep up. The individualized, self-paced approach of CBE has proven to be a remedy for this problem of individual differences.

2. To expand the University's educational market. The market needs a delivery system which can economically deliver instruction over a wide geographical area. Through computer-based techniques, the University can reach more students. For example, if three people in Georgetown wanted to learn Persian, PLATO could teach them whereas a regular course would be cancelled because of small enrollment. This aspect becomes even more important as the learner population is becoming demographically more adult.

3. To reduce the time needed for instruction. Computer-based, self-paced techniques make it possible for students to finish courses in less than the normal fourteen-week semester. Students can complete degrees ahead of schedule, thereby reducing the cost of instruction to parents and taxpayers.

4. To emphasize the intrinsic joy of learning and deemphasize competition with peers as a motivating force. In the computer-based environment the anxieties associated with the traditional classroom are minimized. Students are free to respond as they wish without fear of ridicule from peers or teachers. In such an environment learning is a lot of fun, and motivation is high.

5. To enable students to develop a richer intuitive grasp of complex phenomena through graphic visual representation. Especially applicable to PLATO is the saying that "A picture is worth a thousand words." The ability of PLATO to create interactively a display suited to the student's specific learning needs cannot be overestimated.

6. To provide students with access to a wide range of data for checking out hypotheses. A good example of this benefit is the population dynamics program. Stored in the computer are up-to-date data on the populations of countries throughout the world. The student is able to set variables which affect the futures of those populations, such as time and extent of famines, and see the effects they have on future generations.

7. To enable students to learn more of the complexities of phenomena through modeling and simulation. In addition to providing drill-and-practice and tutorials on various subjects, computers allow students to create models and simulate complex phenomena. For example, students can make electronic circuits, design clothes, compose music, draw pictures, mix chemicals, breed fruit flies, and then study the results of the models and simulations. Such flexibility is not a regular part of American education; it should be.

8. To encourage students to tailor their learning experiences to meet their own objectives. How often do students complain that they did not get what they wanted out of a course? They may have met the instructor's objectives, but they did not meet their own goals. Computers can help them do both. For example, in the University's advanced music theory courses, very little time is spent on set theory. However, some students want to explore it in depth. It is a complex analytical system that cannot be learned by the average student reading a book. Interactive instruction in this area is made available to students who want it by means of PLATO's set theory program. There are ten hours of instruction available for students who want to learn set theory, including periodic tests which assure the students that they are mastering the material. In this way, students are encouraged to extend their learning beyond the requirements of the course.

9. To give immediate feedback. One of the greatest advantages of computer-based techniques is immediate feedback. Through individual interaction with the computer, students partake in a dialogue in which they receive instantaneous responses to their input. No other medium provides this interaction, a benefit that has led to the documentation of significant improvement of instruction in such diverse areas as anesthesiology, French, music, mechanics, dentistry, sociology, calculus, geography, ecology, health, physics, and accounting.

10. To provide students with an anonymous way of asking questions about sensitive matters. Recent research has shown that the use of anonymous sign-ons that let students use PLATO without revealing their identities has encouraged students to ask questions and get responses on sensitive issues which they would normally be afraid to discuss. PLATO's group notesfile capabilities enable students not only to ask questions and get responses to their own personal concerns, but also to see the questions and responses anonymously written by other students. Especially in the area of sex education, this has proven to be an excellent means of allowing students to explore sensitive personal issues.

11. To provide maximum flexibility. Microelectronic technology has progressed to the point at which practically any electronic device can be connected to a microcomputer. Peripherals include touch panels, light pens, mice, joysticks, speech synthesizers, music keyboards, videodisc players, and compact discs. Interface standards allow new peripherals to be connected as soon as they are invented.

APPENDIX A

LESSONS PUBLISHED BY THE UNIVERSITY OF DELAWARE

Lessons Published by the University of Delaware

Lessons for the PLATO Network

Lesson Titles	Lesson Authors	Published
Agriculture		
Dance Language in Honey Bees	Caron, Mason, Sharnoff, Greenberg	2/86
What's My Kind? An Insect Identification Game	Mason, Sharnoff, Charles, Brymer, Andrews	5/85
Architectural Drawing		
Beginning Drafting	Frank, Gil, Nichol	5/84
Lessons in Architectural Drawing, Introduction	Gil, Frank, Boenig	6/85
Lessons in Architectural Drawing, Sketch Lines	Gil, Frank, Boenig	6/85
Lessons in Architectural Drawing, Architectural Lettering	Gil, Boenig	6/85
Lessons in Architectural Drawing, Architectural Symbols	Gil, Boenig	6/85
Lessons in Architectural Drawing, Dimensioning	Gil, Frank, Boenig	6/85
Biology		
Gene Mapping by Conjugation Analysis	Olsen	5/84
A Temperature Sensitive Morphological Mutant of Drosophila Melanogaster	Sheppard, Bergey	5/84
Chemical Engineering		
Chemical Equilibrium	Sandler, Schwarz, Davis	11/84
Chemical Equilibrium Constant Calculation Program	Sandler, Schwarz, Davis	11/84
Corresponding States Principle, Lesson I: Introduction to the Factor Diagram	Sandler, Semprebon	11/84
Corresponding States Principle, Lesson II: Use of the Compressibility Factor Diagram	Sandler, Semprebon	11/84
Corresponding States Principle, Lesson III: The Enthalpy Departure Diagram	Sandler, Semprebon	11/84

Lesson Titles	Lesson Authors	Published
Desuperheater	Sandler, Harrell, Williams	11/84
Expansion of an Ideal Gas	Sandler, Harrell, Williams, Warren, Schwarz	11/84
The Filling of Gas Cylinders	Sandler, Harrell, Williams, Semprebon	11/84
Modeling of a Draining Tank	Sandler, Schwarz, Monarski	11/84
The Rankine Refrigeration Cycle	Sandler, Semprebon, Lamb	11/84
Steam Turbine	Sandler, Harrell, Monarski, Warren, Schwarz	11/84
Vapor-liquid Equilibrium in Binary Mixtures	Sandler, Harrell, Semprebon	1/84
Computer Science		
Push-Down Automata Simulator	Weischedel, Joseph Maia	5/82
Turing Machine Simulator	Weischedel, Joseph Maia	5/82
Mathematics		
Derivatives, Difference Quotients, and Increments	Stickney	2/85
Differentiation Formulas	Stickney	2/85
Glyphs	Sloyer, Sacco, Copes, Smith, Kowalski	5/85
Mathematics in Medicine	Sloyer, Copes, Sacco, Smith, Kowalski	5/86
Numerical Integration	Stickney	2/85
Polar Coordinates	Stickney	2/85
Properties of Integrals	Stickney	2/85
Root-Finder and Function Plotter	Stickney	2/85
Surface Plotter	Stickney	2/85
Two-Variable Function Plotter	Stickney	2/85
Music		
Bass Figurization	Arenson, Nelson, Monarski	10/85
Bass Figurization (Instructor)	Arenson, Nelson, Monarski	10/85

Lesson Titles	Lesson Authors	Published
Basic Part Writing	Arenson, Nelson	10/85
Basic Part Writing (Instructor)	Arenson, Nelson	10/85
Beat Divisions and Units	Arenson, Nelson	10/85
Beat Divisions and Units (Instructor)	Arenson, Nelson	7/79
Competency-Based Chord Quality Drill	Hofstetter, Lynch	7/79
Competency-Based Harmonic Dictation Drill	Hofstetter, Lynch	7/79
Competency-Based Interval Dictation Drill	Hofstetter, Lynch	7/79
Competency-Based Melodic Drill	Hofstetter, Lynch	7/79
Competency-Based Rhythmic Drill	Hofstetter, Lynch	7/79
Chord Construction and Identification	Arenson, Nelson	10/85
Chord Construction and Identification (Instructor)	Arenson, Nelson	10/85
Guide to the GUIDO Written Music Theory System	Arenson, Nelson, Conrad	10/85
GUIDO Ear-Training System	Hofstetter, Lynch	1/81
Half Steps and Whole Steps	Arenson, Nelson, Sloyer	10/85
Half Steps and Whole Steps (Instructor)	Arenson, Nelson, Sloyer	10/85
Key Signatures	Arenson, Nelson, Monarski	10/85
Key Signatures (Instructor)	Arenson, Nelson, Monarski	10/85
Note Reading	Arenson, Nelson, Monarski	10/85
Note Reading (Instructor)	Arenson, Nelson, Monarski	10/85
Note Reading Drill	McCarthy, Braendle	1/85
Partials	Arenson, Nelson	10/85
Partials (Instructor)	Arenson, Nelson	10/85

Lesson Titles	Lesson Authors	Published
Rhythmic Notation	Arenson, Nelson	10/85
Rhythmic Notation (Instructor)	Arenson, Nelson	10/85
Scales and Modes	Arenson, Nelson, Monarski	10/85
Scales and Modes (Instructor)	Arenson, Nelson, Monarski	10/85
Transposition	Arenson, Nelson	10/85
Transposition (Instructor)	Arenson, Nelson	10/85
Written Intervals	Arenson, Nelson	10/85
Written Intervals (Instructor)	Arenson, Nelson	10/85
Physical Education		
Activity Self-Assessment	Kelly, Richards, Mattera, Bishop, Berrang	5/85
Basic Racquetball Strategies for Doubles Play: Defensive Positions	Kent, Bayalis, Byrne, Balogh, Hart	3/85
Basic Racquetball Strategies for Doubles Play: Offensive Positions	Kent, Bayalis, Berrang, Balogh, Bishop	3/85
Basic Racquetball Strategies for Doubles Play: Quiz Offensive Positions	Kent, Bayalis, Balogh, Giniger	3/85
Fitness Part 1: Types of Fitness	O'Neill, Richards, Berrang, Galla	7/84
Fitness Part 2: Ingredients of Fitness	O'Neill, Richards, Bayalis, Correll, Berrang, Giniger	3/85
Fitness Part 3: Designing a Personalized Fitness Program	O'Neill, Berrang, Bayalis, Galla, Byrne	7/84
Mathematical Review for Biomechanics (and Related Fields): The Laws of Signed Numbers	Barlow, Bayalis, Balogh	12/85
Mathematical Review for Biomechanics (and Related Fields): Balancing Equations	Barlow, Bayalis, Balogh	12/85

Lesson Titles	Lesson Authors	Published
Mathematical Review for Biomechanics (and Related Fields): Formula Transformation	Barlow, Bayalis, Byrne	12/85
Mathematical Review for Biomechanics (and Related Fields): Proportionality	Barlow, Bayalis, Richards, Byrne	12/85
Mathematical Review for Biomechanics (and Related Fields): Unit Conversion	Barlow, Bayalis, Correll, Balogh	12/85
Mathematical Review for Biomechanics (and Related Fields): Trigonometric Functions	Barlow, Bayalis, Correll, Balogh	12/85
Mathematical Review for Biomechanics (and Related Fields): Vector Motion Analysis I	Barlow, Bayalis, Correll, Balogh, Byrne	12/85
Mathematical Review for Biomechanics (and Related Fields): Vector Motion Analysis II	Barlow, Bayalis, Correll, Balogh, Byrne	12/85
Mathematical Review for Biomechanics (and Related Fields): Vector Motion Analysis III	Barlow, Bayalis, Correll, Balogh, Byrne	12/85
Mathematical Review for Biomechanics (and Related Fields): Vector Motion Analysis IV	Barlow, Bayalis, Correll, Balogh, Byrne	12/85
Volleyball Strategy Lessons: A Drill and Practice Lesson Dealing with 6-2 Offensive and 2-4 Defensive Strategies Used in Volleyball	Viera, Markham, Balogh	7/84
Volleyball Strategy Lessons: Five Situation Drills Dealing with the 4-2 Offensive and 2-1-3 Defensive Strategies Used in Volleyball	Viera, Markham, Mattera	7/84
Physics		
The Positions of the Planets	Lamphier	2/86
PLATO and OCBI		
Information System for Small Documents	Laubach	12/81
UD Lesson Catalog System	Seiler, Anderer	1/82

Lessons for the Apple II+, IIe, and IIc

Lesson Titles	Lesson Authors	Published
Artifex Verborum	Culley, Newman, Sine, Oberem, Leach, L. Frank, M. Frank	6/84
Cursus Honorum: A Latin Verb Game	Culley, Sine, Oberem, Leach, L. Frank, M. Frank	6/84
Mare Nostrum	Culley, Haughay, Newman, Sine, Leach, L. Frank, M. Frank	6/84
Translat	Culley, Sine, Newman, Leach, L. Frank, M. Frank, Hyde, Schnitzius	6/84
The Verb Factory	Culley, Sine, Oberem, Leach, M. Frank, L. Frank	6/84

Lessons for the IBM PC, XT, and AT

The Card Catalog	Richards, Sundermier, Jarom, Hamadock	1/86
Government Documents Indexes	Richards, Sundermier, Devore, Jarom	1/86
Newspaper Indexes	Richards, Sundermier, DiZio, Jarom	1/86
Periodical Indexes	Richards, Sundermier, Jarom	1/86

Lessons for Micro PLATO

GUIDO Ear-Training System, Micro PLATO Version	Hofstetter, Conrad, Wiley	1/83

APPENDIX B

UNIVERSITY OF DELAWARE PLATO LESSONS PUBLISHED BY THE CONTROL DATA CORPORATION

University of Delaware PLATO Lessons Published by the Control Data Corporation

Lesson Titles	Lesson Author(s)	Published	Courseware Classification
Benefits	Sharf, Collings, et al.	pending	
Custodian	Sharf, Frank, et al.	pending	
Exploring Careers	Sharf, Collings, et al.	10/81	F
Exploring Careers (revision and expansion)	Sharf, Collings, et al.	pending	
Secretary: Skills and Careers	Sharf, Frank, et al.	pending	
What is Break-Even Point	Di Antonio, Bizoe	4/82	
Hang-a-Spy	Weissman	4/82	B1
Cursus Honorum	Culley	12/79	B1
Verb Factory	Culley	12/79	B1
Film Motion Analysis	Barlow, Markham	5/83	B1
Volleyball	Viera, Markham	4/82	B1
Internal Force	Snyder	4/82	B1

APPENDIX C

LIST OF TITLES OF COMPUTER-BASED INSTRUCTION PAPERS PUBLISHED BY UNIVERSITY OF DELAWARE FACULTY AND STAFF

List of Titles of Computer-Based Instruction Papers Published by University of Delaware Faculty and Staff

Arenson, Michael A. 1984. Computer-Based Instruction in Musicianship Training: Some Issues and Answers. Computers and the Humanities, Vol. 18, pp. 157-163.

Arenson, Michael, and Hofstetter, Fred T. 1983. High-Tech Models for Music Learning: The GUIDO System and the PLATO Project. Music Educators Journal, January, Vol. 69, No. 5, pp. 46-51.

Arenson, Michael. 1982. The Effect of a Competency-Based Computer Program on the Learning of Fundamental Skills in a Music Theory Course for Non-Majors. Journal of Computer-Based Instruction, Vol. 9, No. 2, pp. 55-58.

Arenson, Michael, ed. 1982. National Consortium for Computer-Based Instruction 1982 Courseware Directory.

Arenson, Michael. 1982. The Use of A Table Driver for Individualized Design of Computer-Based Instruction Materials in Music Theory. Proceedings, ADCIS Conference, Vancouver, British Columbia, Canada, pp. 228-230.

Arenson, Michael. 1979. Computer-Based Ear-Training Instruction for Non-Music Majors. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 949-958.

Barlow, David A., Markham Jr., A. Stuart, and Richards, James G. 1979. PLATO Facilitation of Precision Motor Analysis in Biomechanics. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 1005-1012.

Boettcher, Elaine G., Alderson, Sylvia F., and Saccucci, Michael S. 1981. A Comparison of the Effects of Computer-Assisted Instruction Versus Printed Instruction on Student Learning in the Cognitive Categories of Knowledge and Application. Journal of Computer-Based Instruction, Vol. 8, No. 1, pp. 13-17.

Brooks, Morris W., and Wenger, Ronald H., eds. 1982. Microcomputers in Education: A Handbook to Support Teacher Development Courses and Workshops in the State of Delaware.

Charles, Thomas C., and Stiner, Frederic M., Jr. 1983. Introducing Computers into the Principles of Accounting Course: The University of Delaware Experience. Proceedings of the 9th International Conference on Improving University Teaching, University of Maryland University College and National Institute for Higher Education, Dublin, Ireland, July 6-9, pp. 357-365.

Cotugna, Nancy, Corrozi, Ann Marie, and Berrang, Clare. 1983. Computerized Nutrition Counseling in a Coordinated Undergraduate Program. Journal of the American Dietetic Association, February, Vol. 82, No. 1, pp. 182-183.

Culley, Gerald R. 1984. Developing "Smart" Language Lessons. Published in 1985, Proceedings of the Fourth Delaware Symposium on Language Studies, ed. by Stephanie Williams (Norwood, NJ: Ablex Publishing), pp 268-72.

Culley, Gerald R. 1982. A Computer-Aided Study of Confusion in Latin Morphology. Linguistics and Literacy, ed. by William Frawley (New York: Plenum Press, 1982), pp. 239-254.

Culley, Gerald R. 1981. Learning How They Learn: Computer Analysis of Latin Students' Errors. Spring meeting of the Classical Association of the Atlantic States, Newark, Delaware, May 1-2.

Culley, Gerald R. 1980. Individualized Latin at Delaware: A Progress Report. Proceedings, the Second National Conference on Individualized Instruction in Foreign Languages, Ohio State University, Columbus, Ohio, October 24-25, pp. 75-79.

Culley, Gerald R. 1980. When PLATO Knows Latin: Benefits of Letting the Computer Inflect the Forms. Proceedings, ADCIS Conference, Washington, D.C., March 31- April 3, pp. 237-240.

Culley, Gerald R. 1979. Computer-Assisted Instruction and Latin: Beyond Flashcards. Classical World, Vol. 72, No. 7, pp. 393-401.

Culley, Gerald R. 1979. Two-Pronged Error Analysis from Computer-Based Instruction in Latin. University of Delaware Symposium on Language and Linguistics.

Culley, Gerald R. 1978. Beyond Flashcards: Using the Computer's Power. American Philological Association, Vancouver, British Columbia, Canada.

Farnham-Diggory, S., and Nelson, Billie. 1982. Cognitive Analyses of Basic School Tasks. Advances in Applied Developmental Psychology, Vol. 1.

Frank, Louisa, and Smith, Lynn H. 1984. The Conversion of PLATO Courseware to the Apple Microcomputer. Proceedings, ADCIS Conference, Columbus Ohio, May 14-17, pp. 92-96.

Garton, Roland, Reed, Mary Jac, Reed, George, and Stevens, Evelyn. 1984. Developing a CBI Course: The Process. Proceedings, ADCIS Conference, Columbus, Ohio, May 14-17, pp. 142-148.

Garton, Roland, Reed, Mary Jac, Reed, George, and Stevens, Evelyn. 1984. Programming a CBI Course: A Case Study. Proceedings, ADCIS Conference, Columbus, Ohio, May 14-17, pp. 149-155.

Garton, Roland, and Silver, John. 1981. Approaches to Converting PLATO Courseware to Computer-Based Instruction. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 162-166.

Hoffman, James E., and Nelson, Billie. 1981. The Role of Attentional Resources in Automatic Detection. University of Delaware, Department of Psychology, Research Report No. 8101.

Hoffman, James E., and Nelson, Billie 1980. Spatial Selectivity in Visual Search. University of Delaware, Department of Psychology, Research Report No. 8002 (also Perception and Psychophysics, Volume 30, pp 283-290). Portions of these data were presented at the 21st annual meeting of the Psychonomic Society, St. Louis, Missouri, November.

Hoffman, James E., and Laubach, Mark. 1980. Examination of a PLATO-Based Psychology Research Laboratory for Visual Perception. Proceedings, ADCIS Conference, Washington, D.C., March 31-April 3, pp. 232-234.

Hoffman, James E., Nelson, Billie, and Laubach, Mark. 1980. Controlled and Automatic Detection. Office of Naval Research Report No. 8001.

Hoffman, James E., Nelson, Billie, and Laubach, Mark. 1979. A Dual Task Analysis of Controlled and Automatic Detection. Presented at the 20th annual meeting of the Psychonomic Society, Phoenix, Arizona.

Hofstetter, Fred T. 1984. Perspectives on a Decade of Computer-Based Instruction. Dean Lecture, ADCIS Conference, Columbus, Ohio, May 14-17. Journal of Computer-Based Instruction, Winter 1985, Vol. 12, No. 1, pp. 1-7.

Hofstetter, Fred T. 1983. The Design, Development, and Implementation of the University of Delaware Sound Synthesizer. Proceedings, ADCIS Conference, Denver, Colorado, May 9-13, pp. 197-202.

Hofstetter, Fred T. 1982. The Cost of PLATO in a University Environment. Proceedings, the First National Congress on Computers in Education, University of Stellenbosch, South Africa, April 13-16.

Hofstetter, Fred T. 1982. The Micro GUIDO Ear-Training System. In: The Educator's Guide to Computers. Carrollton: Association for Supervision and Curriculum Development.

Hofstetter, Fred T. 1981. Computer-Based Instruction: Roots, Origins, Applications, Benefits, Features, Systems, Trends and Issues. Prepared for the International Sales Meeting of the Digital Equipment Corporation, Amelia Island, Florida, November 10-12.

Hofstetter, Fred T. 1981. Computer-Based Recognition of Perceptual Patterns in Rhythmic Dictation Exercises. Journal of Research in Music Education, Vol. 29, No. 4, pp. 265-277.

Hofstetter, Fred T. 1981. Investing in Computer Technology: Criteria and Procedures for System Selection. Proceedings, the National Conference on Technology and Education, sponsored by the Institute for Educational Leadership of the George Washington University, the Shoreham Hotel, Washington, D.C., January 6, pp. 45-53.

Hofstetter, Fred T. 1981. Synopsis of the University of Delaware's Office of Computer-Based Instruction. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 5-11.

Hofstetter, Fred T. 1980. Computer-Based Aural Training: The GUIDO System. Journal of Computer-Based Instruction, Vol. 7, No. 3, pp. 84-92.

Hofstetter, Fred T. 1980. Computer-Based Recognition of Perceptual Patterns in Chord Quality Dictation Exercises. Journal of Research in Music Education, Vol. 28, No. 2, pp. 83-91.

Hofstetter, Fred T. 1979. Evaluation of a Competency-Based Approach to Teaching Aural Interval Identification. Journal of Research in Music Education, Vol. 27, No. 4, pp. 201-213.

Hofstetter, Fred T. 1978. Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises. Journal of Research in Music Education, Vol. 26, No. 2, pp. 111-119.

Hofstetter, Fred T. 1975. GUIDO: An Interactive Computer-Based System for Improvement of Instruction and Research in Ear-Training. Journal of Computer-Based Instruction, Vol. 1, No. 4, pp. 100-106.

Kent, James W., and Bayalis, Patricia A. 1980. Doubles Play Strategies in Racquetball on PLATO. Proceedings, International Symposium on the Effective Teaching of Racquet Sports, University of Illinois, Champaign, Illinois, June 11-14.

Kent, James W., Barlow, David A., and Craig, Robert. 1980. Relationship Between Ball Velocity and Selected Biomechanical Factors for Male and Female Players in the Backhand Kill in Racquetball. Proceedings, International Symposium on the Effective Teaching of Racquet Sports, University of Illinois, Champaign, Illinois, June 11-14.

Kline, Loren. 1980. Analysis of the Soccer Throw-In. NSCAA Annual Meeting, Philadelphia, Pennsylvania, January 18.

Lambrecht, Madeline. 1985. The Value of Computer-Assisted Instruction in Death Education. "The Thanatology Curriculum for Schools of Medicine, Nursing, and Related Health Professions," Archives of the Foundation of Thanatology Symposium, March 14-16, Vol. 11, no. 4, p. 18.

Lambrecht, Madeline. 1983. PLATO Helps Nursing Students Confront their Unexpressed Feelings about Death and Dying. Abstracts of the 9th International Conference on Improving University Teaching, University of Maryland University College and National Institute for Higher Education, Dublin, Ireland, July 6-9, p. 147.

Mahler, William A., and Sharf, Richard S. 1977. CAREERS: A Computer-Based Career Guidance System. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24.

McBride, Suzanne R. 1983. Tutor LOGO: Developing a Procedural Model of Children's Programming in a Research-Based Learning Environment. Proceedings, ADCIS Conference, Denver, Colorado, May 9-13, pp. 222-229.

Meisel, C. Julius. 1983. Social Comparison Behavior Among Mainstreamed Handicapped Children. Annual Convention of the Council for Exceptional Children, Detroit, Michigan, April 8.

Meisel, C. Julius, and Smith, George A. 1981. A Comparison of Recall Patterns Among Autistic and Retarded Learners. Presented at the Regional XIII Meeting of the American Association on Mental Deficiency (AAMD), October.

Morrison, James L. 1983. Utilizing Computer Technology in Consumer and Business Education. Delaware Business Journal, Vol. III, No. 2, pp. 17-21.

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Mulford, George W. 1980. Who Needs Computers? Proceedings, the Second National Conference on Individualized Instruction in Foreign Languages, Ohio State University, Columbus, Ohio, October 24-25, pp. 193-199.

Mulligan, James G. 1984. A Cost Function for Computer-Assisted, Programmed Instruction. Journal of Economic Education, Fall, pp. 275-281.

Murray, Clella B. 1985. Providing Access to Computer-based Education in the Public Library. Proceedings, ADCIS Conference, Philadelphia, Pennsylvania, March 25-28, pp. 216-221.

Nichols, Raymond D. 1980. A PLATOnic Dialog. Print, Vol. 34, No. 6, pp. 64-69.

Nichols, Raymond D. 1979. The PLATO Display In The Teaching Of Optical Letter-spacing. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 1022-1026.

Nichols, Raymond D. 1979. PLATO in the Teaching of Foundation Visual Design. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 986-990.

Nichols, Raymond D., and Wilson, James H. 1977. The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 22-24, pp. 248-255.

Paulanka, Betty. 1985. A Profile of Learner Traits and Learning Outcomes with Computer-Assisted Instruction. Proceedings, ADCIS Conference, Philadelphia, Pennsylvania, March 25-28, pp. 71-75.

Reed, George, Frank, Louisa, Balogh, Nancy, and Richards, Deborah. 1985. Towards the Development of an IBM PC Authoring System. Proceedings, ADCIS Conference, Philadelphia, Pennsylvania, March 25-28, pp. 187-192.

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Reed, Mary Jac, and Porter, Michael. 1984. A Review of Digital's Courseware Authoring System. Journal of Computer-Based Instruction, Summer, Vol. 11, No. 3, pp. 68-69.

Roe, Peter G. 1983. Ethnoaesthetics and Design Grammars: Shipibo Perceptions of Cognate Styles. 81st Annual Meeting of the American Anthropological Association, Washington, D.C., December 6.

Seiler, Bonnie A. 1981. Applying a Systematic Approach to CBE Development in an Academic Environment. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 305-310.

Sharf, Richard S. 1984. The Effect of Occupational Information on a Computerized Vocational Counseling System. Vocational Guidance Quarterly, December, pp. 130-137.

Sharf, Richard S. 1984. Vocational Information-Seeking Behavior: Another View. Vocational Guidance Quarterly, December, pp. 120-129.

Sloyer, Clifford, and Smith, Lynn H. 1983. Applied Mathematics via Student Created Computer Graphics. Journal of Computers in Mathematics and Science Teaching, Spring, pp 17-20.

Stabosz, Rae D., and Weissman, Jessica. 1984. A Model for the PLATO Services Organization in a Large, Multi-System CBE Environment. Proceedings, ADCIS Conference, Columbus Ohio, May 14-17, pp. 156-162.

Tobin, Aileen W., and Venezky, Richard L. 1979. The Effect of Orthographic Structure on Letter Search: An Attempt to Replicate and Extend Previous Findings. Presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, April 8.

Wenger, Ronald H., and Brooks, Morris W. 1984. Diagnostic Uses of Computers in Precalculus Mathematics. Computers in Mathematics Education, 1984 Yearbook of the National Council of Teachers of Mathematics.

Weaver, Charles A., and Seiler, Bonnie Anderson. 1977. Computer Assistance in the Social Processes of Learning. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24, pp. 26-38.

Weissman, Jessica, and Molad, Clarisse. 1981. Guidelines for Contracting an Outside CBE Development Vendor. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 318-321.

Wilson, James H., and Paden, Elain P. 1978. The Effects of Drill Structure on Learning in Phonetics Lessons. Proceedings, ADCIS Conference, Dallas, Texas, March 1-4, pp. 448-456.

APPENDIX D

CATALOG OF PROGRAMS UNDER DEVELOPMENT IN THE OFFICE OF COMPUTER-BASED INSTRUCTION

Catalog of Programs under Development
In the Office of Computer-Based Instruction

PART I: PLATO LESSONS

INSTRUCTIONAL LESSONS

Project	Title	Filename	Developer	Programmer
Accounting	Accounting Sample Test	acc207t	A. DiAntonio	K. Slaughter M. Berrang
	Costing Methods	costing	J. Gillespie	W. Childs
Advisement Center	General Academic Information	maini	P. Rees and Staff	S. Correll
		acinfo	P. Rees and Staff	S. Correll
		actutor	P. Rees and Staff	S. Correll
		actutor2	P. Rees and Staff	S. Correll
		actutor3	P. Rees and Staff	S. Correll
		actutor4	P. Rees and Staff	S. Correll
		actutor5	P. Rees and Staff	S. Correll
	Exploring Individualized Curriculum Options	indivcur	P. Rees A. Crowley	S. Correll
Agriculture	All in the Family, An Insect Family Identification Game	inuse	C. Mason P. Andrews	R. Charles
	Anatomy and Physiology on PLATO	agplato	Sammelwitz	D. Anderer M. Larkin

Project	Title	Filename	Developer	Programmer
Agriculture (continued)	An Introduction to the Endocrine System: Terminology and Definitions	endo1	Sammelwitz	D. Tripp S. Waeber M. Porter M. Larkin
	An Introduction to the Endocrine System: Listing and Classifications of Endocrine Structures	endo2	Sammelwitz	D. Tripp S. Waeber M. Porter M. Larkin
	An Introduction to the Endocrine System: Locations of Endocrine Structures in Mammalian Species	endo3	Sammelwitz	D. Tripp S. Waeber M. Porter M. Larkin
	An Introduction to the Endocrine System: Locations of Endocrine Structures in Avian Species	endo4	Sammelwitz	D. Tripp S. Waeber M. Porter
	An Introduction to the Endocrine System: Hormones Secreted by the Endocrine Structures	endo5	Sammelwitz	D. Tripp S. Waeber M. Porter M. Larkin
	APS101: Sample Test Questions	apsintro	Sammelwitz	Sammelwitz
	Genetic Relations	relations	G. Haenlein G. Sharnoff	C. Lewis D. Tripp M. Larkin G. Wellmaker
	Preparing a Balanced Animal Ration	rations	Saylor G. Sharnoff	M. Larkin G. Sharnoff
	Preparing a Balanced Animal Ration Laboratory	fration	Saylor G. Sharnoff	G. Sharnoff Anderson M. Larkin
	Senses: Classifying the Senses	senses	Sammelwitz G. Sharnoff	C. Murray
	Senses: Identifying the Senses	senseid	Sammelwitz G. Sharnoff	J. Landis

Project	Title	Filename	Developer	Programmer
Agriculture (continued)	Senses: Identifying Function of Ear Structures	earquiz	Sammelwitz G. Sharnoff	M. Larkin
Agriculture: PLM	Digestion	apsmod4	Sammelwitz	Sammelwitz
	Endocrine System	apsmod2	Sammelwitz	Sammelwitz
	Life Organization	apsmod1	Sammelwitz	Sammelwitz
	Metabolism	apsmod7	Sammelwitz	Sammelwitz
	Muscles	apsmod6	Sammelwitz	Sammelwitz
	Reproduction	apsmod3	Sammelwitz	Sammelwitz
	Respiratory System	apsmod	Sammelwitz	Sammelwitz
	Skin and Bones	apsmod5	Sammelwitz	Sammelwitz
Agricultural Economics	Simag: An Agribusiness Simulation	simag	M. Hudson Toensmeyer A. DiAntonio	C. Leefeldt
Anthropology	The Anthropological Study of Art Style	roe1	P. Roe	K. Sims
	Anthropological Descent Theory	descent2	N. Schwartz M. Fortner	C. Collings K. Sims
	Anthropological Residence Theory	reside2	N. Schwartz M. Fortner	C. Collings K. Sims
	Cellular Structure	physanthro	M. Hamilton M. Berrang	M. Berrang
	Grammatical Study of Art Style Part 1	roe2a	P. Roe	C. Brooks S. Lamphier K. Sims
	Grammatical Study of Art Style Part 2	roe2b	P. Roe	C. Brooks S. Lamphier K. Sims
Art	Aesthetic Value	value	R. Nichols	Joseph Maia
	Composition Using Grey Scale Tones	gscale	R. Nichols	Joseph Maia B. Williams

Project	Title	Filename	Developer	Programmer
Art (continued)	Design Aesthetics and Creation	des	R. Nichols	C. Wickham J. Trueblood C. Vinson
	Newspaper Copy Fitting	copyfit	R. Nichols	S. Cox
	Optical Letterspacing	nols	R. Nichols	C. Wickham J. Trueblood S. Cox
	Painting on a Computer	mpt	R. Nichols B. Williams	B. Williams
	Pigment Identification	pigid	J. Hill-Stoner	L. Frank B. Listman C. Patchel
	Random Dot Pattern Generator	random	R. Nichols	K. Abele
	Rotating Squares Generator	square	R. Nichols J. Wilson	J. Wilson
Biology	The lac Operon in E. coli.	operona	D. Sheppard	K. Bergey B. Cooley E. Downey D. Colburn
		operonb	D. Sheppard	K. Bergey B. Cooley E. Downey D. Colburn
		operonc	D. Sheppard	K. Bergey B. Cooley D. Colburn
	Crossing over in Drosophila	crossing	D. Sheppard	P. Draus P. Mattera
	Human Karyotype Analysis	karyo	A. Olsen	A. Olsen
	Meiosis	meiofine	J. Beyer A. Olsen	J. Beyer
	Mitosis and Cell Division	mitofine	J. Beyer	J. Beyer
	Molecular Basis of Mutation	mutagen	D. Sheppard	P. Draus

Project	Title	Filename	Developer	Programmer
Biology (continued)	Population Genetics Simulation	beans	A. Clark	B. Cooley
	Positioning of Genes In Bacteria by Deletion Mapping	delmap	D. Sheppard	J. Beyer
		delmapb	D. Sheppard	J. Beyer
	Recombinant DNA: Techniques and Applications	recomb	D. Sheppard	J. Beyer P. Draus E. Bishop
	Somatic Cell Genetics	somatic	D. Sheppard	J. Beyer
		somaticb	D. Sheppard	J. Beyer
	The Histidine Operon in Salmonella Typhimurium	histid	D. Sheppard	P. Draus
Chemical Engineering	Equations of State	thtest1	S. Sandler	S. Correll P. Andrews
	Mass Balance With Chemical Reactions	nmb3	S. Sandler J. Ayres A. Semprebon	L. Frank J. Ayres A. Semprebon
	Vapor-Liquid Equilibrium	nvliquid	S. Sandler J. Ayres A. Semprebon	L. Frank J. Ayres A. Semprebon
Chemistry	Determining Shapes of Molecules: VSEPR	vsepr	E. Davis R. Garton	S. Digel R. Garton L. Vishnevetsky
		vsprquiz	E. Davis R. Garton	S. Digel R. Garton L. Vishnevetsky
		vspredit	E. Davis R. Garton	S. Digel R. Garton L. Vishnevetsky
Counseling	The Centrality of Work	wrkethic	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter

Project	Title	Filename	Developer	Programmer
Counseling (continued)	Choices	choices	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
	Counseling for Career Decisions	vcouns	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
		vcouns1	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
		vcouns2	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
		vcouns3	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
		vocdev1	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
	Counseling for Career Decisions: A Simulation	vocdism	R. Sharf	L. Frank C. Collings
	The D.O.T	dot	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter

Project	Title	Filename	Developer	Programmer
Counseling (continued)	Holland's Theory of Vocational Development	holland	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
	Parson's Theory of Vocational Development	parsons	R. Sharf	L. Frank C. Collings K. Jones R. Sutor Zembrzuski Slaughter
Economics	Economic Practice Problems	econprob	C. Link J. Miller L. Pienta	Slaughter Zembrzuski P. Bevtel D. Jain S. Lamphier R. Payne B. Polejes
	Fiscal Policy (adapted from University of Illinois)	padend	D. Paden J. Miller	Zembrzuski
	Income Determination with Government (adapted from University of Illinois	consum1	D. Paden J. Miller	Zembrzuski
	Income Determination without Government (adapted from University of Illinois)	consum	D. Paden J. Miller C. Link	Zembrzuski P. Smith
	Supply and Demand	supply	D. Paden J. Miller C. Link	Zembrzuski P. Smith
Education	Read Along with PLATO	readalong	P. Pelosi	J. Weissman
	Factors in Reading Comprehension	readlab	F. Murray	J. Sandler
	Fast Accurate Symbol Transcription in Evaluating of Reading	squiggles	J. Pikulski	D. Braendle

Project	Title	Filename	Developer	Programmer
Education (continued)	Make a Spy	makespy	J. Weissman P. Pelosi B. Seiler	J. Weissman
	Sight Word Attack Team	swat	R. Bianco P. Pelosi J. Weissman B. Seiler	J. Weissman
	Sight Word Teaching Method Simulations	sightword	P. Pelosi	J. Weissman
	Spy Meeting	spymeet	J. Weissman B. Seiler	J. Weissman
	Spot the Spy	spotspy	J. Weissman P. Pelosi B. Seiler	J. Weissman
	Spy Concentration	newtwo	J. Weissman B. Seiler	J. Weissman
	SWAT Promotion Test	swattest	J. Weissman P. Pelosi R. Biano	J. Weissman
	Word Zoo	wordzoo	S. Hansell	J. Weissman
English	The Animal Game	animal	L. Arena S. Homsey J. Weissman	J. Weissman J. Snyder R. Stabosz
	The Animal Game Editor	animaled	S. Homsey R. Stabosz	R. Stabosz J. Snyder
	Diagnostic Test Instructions	ndtins	L. Arena M. Peoples	J. Snyder J. Landis
	IS and ARE, the Missing Links	cdelete	L. Arena M. Peoples J. Weissman	J. Weissman
	"S" on Third: When to Put S on a Verb	threepv	P. Townsend	Jean Maia
	Results for the Diagnostic Test of Classroom English	ndtresul	L. Areana M. Peoples	J. Snyder J. Landis
	Editor for the Diagnostic Test	ndtested	L. Arena M. Peoples	J. Snyder J. Landis

Project	Title	Filename	Developer	Programmer
English (continued)	The Power of Negative Thinking	negative	L. Arena S. Homsey	J. Weissman R. Stabosz
	Learning to BE (Habitual use of BE)	behabit	L. Arena M. Peoples	J. Weissman Jean Maia J. Snyder
Food Science and Human Nutrition	Nutrition and Diabetes Mellitus: Part I Nutritional and Clinical Management of Diabetes Mellitus	diabet1	L. Aljadir	E. Stevens F. Dunham
	Nutrition and Diabetes Mellitus: Part II Estimation of Energy Needs for Weight Control	diabet2	L. Aljadir C. Blanchet	J. Snyder E. Stevens M. Greenberg
	Nutrition and Diabetes Mellitus: Part III Distribution of Calories Among Calorigenic Nutrients and Among Meals	diabet3	L. Aljadir	J. Snyder E. Stevens M. Greenberg
	Nutrition and Diabetes Mellitus: Part IV The American Dietetic Association Exchange System	diabet4	L. Aljadir	J. Snyder E. Stevens M. Greenberg
	Nutrition and Diabetes Mellitus Part V Use of the Exchange System in Meal Planning	ndiabet5	L. Aljadir	J. Snyder E. Stevens M. Greenberg
	Weight Control Topic I: Hormonal Action and Metabolism of Carbohydrate, Fat, and Protein	hormonej	L. Aljadir	E. Stevens F. Dunham C. Patchell
	Weight Control Topic II: Metabolic Basis of Hazardous Dietary Regimens	wt2	L. Aljadir C. Blanchet	E. Stevens S. Garton C. Patchell
	Carbohydrate Metabolism Part I- Overview	pathwy1s	L. Aljadir	K. Troutman K. Fanny M. Greenberg E. Stevens

Project	Title	Filename	Developer	Programmer
Food Science and Human Nutrition (continued)	Carbohydrate Metabolism Part II- Glycogenesis/ Glycogenolysis	pathwy2s	L. Aljadir	K. Troutman M. Greenberg K. Fanny E. Stevens
	Carbohydrate Metabolism Part III- Glycolysis and other pathways	pathwy3s	L. Aljadir	K. Troutman K. Fanny M. Greenberg E. Stevens
Languages	Artifex Verborum	artnset	G. Culley	G. Culley
	¡ESPAÑOL! Lengua y cultura de hoy	hoy1	T. Lathrop	B. Pasapane
		hoy2	T. Lathrop	B. Pasapane
		hoy3	T. Lathrop	G. Mulford
		hoy4	T. Lathrop	G. Mulford B. Pasapane
		hoy5	T. Lathrop	E. Kapp
		hoy6	T. Lathrop	E. Kapp
		hoy7	T. Lathrop	P. Vinall
		hoy8	T. Lathrop	B. Pasapane G. Mulford
		hoy9	T. Lathrop	V. Gardner
		hoy10	T. Lathrop	G. Mulford
		hoy11	T. Lathrop	G. Mulford
		hoy12	T. Lathrop	B. Pasapane V. Gardner
		hoy13	T. Lathrop	G. Mulford
		hoy15	T. Lathrop	A. Haughay G. Mulford
	French Verbs	[illegible]	T. Braun B. Robb	G. Mulford V. Gardner S. Correll C. Marks K. Jones K. Fanny

Project	Title	Filename	Developer	Programmer
Languages (continued)	Latin Substitution and Transformation Drill	vsubdril	D. Williams	D. Williams V. Gardner
	Les quatre cents Mots	vdrill	T. Braun G. Mulford V. Gardner	V. Gardner C. Collings G. Mulford M. Baum K. Jones
	Mare Nostrum: A Game with Latin Nouns and Adjectives	mare	G. Culley	G. Culley
	Multi-language Substitution and Transformation Drill	vsubmake	D. Williams	D. Williams V. Gardner
		subdrill	D. Williams	D. Williams V. Gardner
	Review of English Grammar	udgrammar	G. Culley	G. Culley
	Ringers: A Grammar Recognition Lesson	ringers	G. Mulford	G. Mulford
	Translat: Exercises in Translating Latin Sentences	translat	G. Culley	G. Culley
	Touché: A French Word Order Touch Lesson	touche	G. Mulford	D. Williams
	Underliner: A Word-in-Context Lesson	uldemo	G. Mulford	G. Mulford E. Kapp C. Prettyman
Library	Doing Research? A Beginning Library Research Strategy	nlibdex	P. Arnott FitzGerald L. Masters	J. Snyder C. Parker
	Card Catalog	ncardcat	P. Arnott FitzGerald L. Masters	J. Snyder C. Parker D. Richards
	Periodical Indexes	nperdex	P. Arnott FitzGerald L. Masters	D. Mosby C. Parker D. Richards

Project	Title	Filename	Developer	Programmer
Library (continued)	Newspaper Indexes	nnewspap	P. Arnott FitzGerald L. Masters	Sundermier J. Snyder D. Richards
	Government Documents	ngovdoc	P. Arnott FitzGerald L. Masters	Dominguez Jr. D. Richards
	Locating Library References	nlocate	P. Arnott FitzGerald L. Masters	M. Baum C. Parker
	Test	libtest	P. Arnott FitzGerald L. Masters	D. Richards
	Using the Citation Indexes	cindex	P. Arnott M. Bronner J. Levine J. O'Gorman D. Richards	P. Mattera
	Using the Science Citation Index	sci	P. Arnott M. Bronner J. Levine J. O'Gorman D. Richards	D. Colburn
	Using the Social Sciences Citation Index	ssci	P. Arnott M. Bronner J. Levine J. O'Gorman D. Richards	D. Colburn
	Using the Arts & Humanities Citation Index	ahci	P. Arnott M. Bronner J. Levine J. O'Gorman D. Richards	D. Colburn
Mathematics	Consumption: An Exercise in Graphing and Interpreting Linear Functions	causec1	J. Miller J. Bergman	M. Morrow S. Coburn S. Lesnik
	Cost Functions	causcc4	C. Link	S. Coburn
	Dynamic Programming	dynprog	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum

Project	Title	Filename	Developer	Programmer
Mathematics (continued)	Dynamic Programming	shortpth	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum
		shrubcov	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum
		helmet	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum
		digitize	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum
		dpapx	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith C. Vinson S. Kowalski B. Williams M. Baum
	Graph Theory	graf	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
		chrom	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
		plan	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
		trees	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski

Project	Title	Filename	Developer	Programmer
Mathematics (continued)	Graph Theory	digraf	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
	Math Interactive Problem Package (MIPP) a. Driver Lesson b. Introduction to MIPP	mippdemo	R. Wenger M. Brooks	R. Payne Slaughter
		mippintr	R. Wenger M. Brooks	R. Payne Slaughter
	PLM Curriculum for Intermediate Algebra	pcmathm	B. Daley B. Duch	A. Tripp J. Velonis
	Production Functions	causec3	C. Link	S. Coburn
	The Production Possibility Curve	causec2	J. Miller	S. Lesnik
	Profit Maximization	causec5	C. Link	S. Coburn
	Queues	queue	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
		queue2	C. Sloyer W. Copes W. Sacco L. Smith	L. Smith S. Kowalski
Music	Competency-Based Interval Drill for Pitch Detection	pinter	Hofstetter	W. Lynch M. Baum J. Conrad
	Competency-Based Melody Drill for Pitch Detection	pmelody	Hofstetter	W. Lynch M. Baum J. Conrad
	Interval Hall of Fame	intervals	Hofstetter	W. Lynch
	MusiMatic	musimatic	W. Lynch	W. Lynch
	Orchestration for the University of Delaware Sound Synthesizer	box	Hofstetter	W. Lynch
	Set Names (after Forte)	setnames	Hofstetter	J. Trueblood

Project	Title	Filename	Developer	Programmer
Music (continued)	Seven Basic Rhythms	rrhythm	M. Arenson W. Lynch	R. Preiss
Nursing	Abdominal Perineal Resection: A Patient Care Simulation	peri	M. A. Early	M. Fortner
	Death: A Personal Encounter	ndanding	M. Lambrecht	M. Greenberg E. Stevens
	Locating Human Heart Valves	heartv2	M. A. Early	D. Graper
	Challenge Question Editor	chqgen	E. Stevens	R. Skillman S. Correll
	Challenge Question Driver	chdrive	E. Stevens	R. Skillman S. Correll
	Challenge Question Grader	chscore	E. Stevens	R. Skillman S. Correll
	Introduction to the Format of the Challenge Exam	introtst	M. Fortner	M. Fortner
	Sample Challenge Exam	nursesampl	M. A. Early	M. Fortner Slaughter [illegible]. Williams F. Kazmierczak
	N201 Meds Test	test201	A. Craig	M. Fortner
	The Nursing Process (Adapted from the University of Pittsburgh)	soapie	S. Cudney	J. Trueblood
	The Nursing Process and Psychotropic Medication: An Introduction to Psychopharmacological Nursing	npharm1f	S. Alderson E. Boettcher	E. Stevens F. Dunham
	The Nursing Process and Psychotropic Medication: The Steps of the Nursing Process	ngpharm2	S. Alderson E. Boettcher	M. Greenberg J. Nicholson E. Stevens

Project	Title	Filename	Developer	Programmer
Nursing (continued)	The Nursing Process and Psychotropic Medication: Antipsychotic Medication	spharm3	S. Alderson E. Boettcher	E. Stevens M. Greenberg F. Dunham
	The Nursing Process and Psychotropic Medication: Antianxiety Medication	spharm4	S. Alderson	R. Skillman E. Stevens M. Greenberg B. Polejes F. Dunham
	The Nursing Process and Psychotropic Medication: Antidepressant Medication	spharm5	S. Alderson	L. Smith F. Dunham E. Stevens
	The Nursing Process and Psychotropic Medication: Lithium Carbonate	spharm6	S. Alderson	L. Smith F. Dunham E. Stevens M. Greenberg
Nursing: PLM	Nursing Process	phm3mod1	S. Alderson E. Boettcher	E. Stevens
	Communication	phm3mod2	S. Alderson E. Boettcher	E. Stevens
	Psychoses	phm3mod3	S. Alderson E. Boettcher	E. Stevens
	Antipsychotics	phm3mod4	S. Alderson E. Boettcher	E. Stevens
	Antianxiety Medication I	phm4mod1	S. Alderson	L. Smith E. Stevens
	Antianxiety Medication II	phm4mod2	S. Alderson	L. Smith E. Stevens
	Depression	phm5mod1	S. Alderson	L. Smith E. Stevens
	Antidepressants	phm5mod2	S. Alderson	L. Smith E. Stevens
	Bipolar Disorder	phm5mod3	S. Alderson	F. Dunham E. Stevens
	Lithium Therapy	phm5mod4	S. Alderson	F. Dunham E. Stevens

Project	Title	Filename	Developer	Programmer
Nursing: PLM (continued)	Mobility	lb307m1	E. Jenkins	E. Stevens K. Fanny
	Nutrition I	lb307m2	E. Jenkins	E. Stevens K. Fanny
	Mobility II	lb307m3	E. Jenkins	E. Stevens K. Fanny
	Nutrition II	lb307m4	E. Jenkins	E. Stevens K. Fanny
	Medical Asepsis	lb307m5	E. Jenkins	E. Stevens K. Fanny
	Surgical Asepsis	lb307m6	E. Jenkins	E. Stevens K. Fanny
	Respiration I	lb307m7	E. Jenkins	E. Stevens K. Fanny
	Respiration II	lb307m8	E. Jenkins	E. Stevens K. Fanny
	Injections I	lb307m9	S. Test	E. Stevens J. Morgan
	Injections II	lb307m10	S. Test	E. Stevens J. Morgan
Physical Education	Mathematical Review for Biomechanics (and Related Fields): Pre/Post Test	preptst	D. Barlow P. Bayalis	S. Correll T. Byrne
	Film Motion Analysis Bitpad Version	analbit	D. Barlow	Markham Jr.
	Muscle Identification: Upper Extremities	muscle	K. Handling P. Bayalis	S. Hart
	Muscle Identification: Lower Extremities	muscle2	K. Handling P. Bayalis	S. Hart
	Muscle Identification: Trunk	muscle3	K. Handling P. Bayalis	S. Hart
	Social Dancing	dancer	J. Pholeric	P. Bayalis
PLATO and DCBI	Delaware PLATO System Hardware Configuration	udhard	J. Wilson B. Fortner	B. Fortner D. Anderer

Project	Title	Filename	Developer	Programmer
PLATO and OCBI (continued)	Example of TUTOR Judging Flexibility	udmeow	R. Stabosz	R. Stabosz
	How to Read and Write in a Notefile	raeguide	R. Stabosz	R. Stabosz
	How to Use PLATO	udhelp	J. Weissman B. Seiler	J. Weissman S. Hart
		udhlp	J. Weissman B. Seiler	J. Weissman S. Hart
		sudhelp	J. Weissman B. Seiler	J. Weissman S. Hart
		nhlpstor	J. Weissman B. Seiler	J. Weissman S. Hart
	Information on OCBI	udinfo	Hofstetter J. Wilson	J. Wilson D. Graper
	Programming for the Touch Panel	touchhelp	J. Weissman	J. Weissman
	System Messages -- Who Sent It and Why	messages	J. Weissman	J. Weissman
Political Science	Committee Chairman (adapted from University of Illinois)	npols8	R. Sylves S. Garton	K. Kahn S. Garton R. Smith
	Organization Charts and Public Administration	orgch	R. Sylves S. Garton	J. Hassert
	Political Districting (adapted from University of Illinois)	npols3	R. Sylves S. Garton	S. Gill R. Smith
	Political Science Budget Lesson (adopted from University of Illinois)	npols5	R. Sylves S. Garton	W. Smith R. Smith
Psychology	Anagrams	anagrams	Berg-Cross McLaughlin	J. Sandler
	Conservation	clare	C. Berrang	C. Berrang

Project	Title	Filename	Developer	Programmer
Psychology (continued)	Direct Scaling	dscale	J. Hoffman	J. Weissman R. Krejci M. Frank W. Daniels
	An Experiment in Memory	remember	McLaughlin	J. Sandler
	Eyepath	eyepath	L. C. Skeen	C. Vinson W. Daniels
	Geometrical Optical Illusions	illusion	J. Hoffman J. Weissman	J. Weissman R. Krejci
	The Poggendorf Illusion	pogexp	J. Hoffman	J. Weissman
	Reaction Time and the Measurement of Mental Processes	reactime	J. Hoffman	C. Marks R. Krejci
	Visual Perception	eye1	J. Hoffman	R. Krejci
Security	Professionalism	secprof	J. Schimmel	R. Schwartz
	Public Safety 10 Code	tencode	S. Swain	R. Krejci
Statistics	Statistics Worksheet Lesson	statone	V. Martuza	A. Olsen M. J. Reed G. Feurer
Textiles, Design and Consumer Economics	Sewing Pattern Alteration Laboratory	alterlab	F. Mayhew D. Elias F. Smith	D. Anderer V. Gardner K. Bergey J. Morgan
	Body Measurement	bigbody	D. Elias F. Mayhew	D. Anderer K. Bergey
	Consumer Education Resource Network	consume	H. Stewart	M. Laubach D. Mellor K. Bergey D. Tripp D. Anderer
	Consumer Education Steps to Problem Solving	cesteps	H. Stewart N. McShaw	K. Bergey

Project	Title	Filename	Developer	Programmer
Textiles, Design and Consumer Economics (continued)	Consumer Financial Management	persfin2	J. Morrison D. Richards	M. Dombrowski L. Keil
	Consumer in the Marketplace: Consumption	conecon1	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Information	conecon2	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: The Concept of Consumer Decisioning	conecon3	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Consumer Price Index	conecon4	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Sovereignty in the Marketplace	conecon5	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Time-Probability	conecon6	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Opportunity Costs in the Family	conecon7	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Investment in Human Capital	conecon8	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Rights and Responsibilities	conecon9	J. Morrison	C. Murray *et al*.
	Consumer in the Marketplace: Rationality	conecon10	J. Morrison	C. Murray *et al*.

Project	Title	Filename	Developer	Programmer
Textiles, Design and Consumer Economics (continued)	Consumer in the Marketplace: Consumer Delivery System	coneco11	J. Morrison	C. Murray et al.
	Consumer in the Marketplace: Optimal Consuption Stream	coneco12	J. Morrison	C. Murray et al.
	Consumer in the Marketplace: Product Liability	coneco13	J. Morrison	C. Murray et al.
	Consumer in the Marketplace: Transfer of Income	coneco14	J. Morrison	C. Murray et al.
	Consumer in the Marketplace: Public Policy	coneco15	J. Morrison	C. Murray et al.
	Consumer in the Marketplace: Transfer Payments	coneco16	J. Morrison	C. Murray et al.
	Determining Pattern Alterations	mcd	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias J. Wilson
	Ease Requirements	ease	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias
	Metric Practice	secmet	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias
	Pattern Measurement	patterns	D. Elias F. Mayhew B. Seiler F. Smith	D. Anderer K. Bergey D. Elias J. Wilson
Textiles, Design and Consumer Economics: PLM	Consumption Plan	cctest1	J. Morrison	C. Murray

Project	Title	Filename	Developer	Programmer
Textiles, Design and Consumer Economics: PLM (continued)	Information Plan	cetest2	J. Morrison	C. Murray
	Consumer Decisions	cetest3	J. Morrison	C. Murray
	Consumer Price Index	cetest4	J. Morrison	C. Murray
	Sovereignty	cetest5	J. Morrison	C. Murray
	Time-Probability	cetest6	J. Morrison	C. Murray
	Opportunity Costs	cetest7	J. Morrison	C. Murray
	Human Capital	cetest8	J. Morrison	C. Murray
	Right and Responsibilities	cetest9	J. Morrison	C. Murray
	Rationality	cetest10	J. Morrison	C. Murray
	Delivery System	cetest11	J. Morrison	C. Murray
	Consumption Stream	cetest12	J. Morrison	C. Murray
	Product Liability	cetest13	J. Morrison	C. Murray
	Transfer of Income	cetest14	J. Morrison	C. Murray
	Public Policy	cetest15	J. Morrison	C. Murray
	Transfer Payments	cetest16	J. Morrison	C. Murray
Wellspring Health Education Project	Contraception: Choosing a Method That's Best for You	precontr	A. Lomax	C. Berrang J. Merryman
	Contraception: Information	contra	Dominguez A. Lomax	Dominguez
	Sex Education Referral Network	refer	A. Lomax	M. Laubach D. Tripp
	Sex Myth Quiz	myth	Dominguez A. Lomax	Dominguez

Project	Title	Filename	Developer	Programmer
Wellspring Health Education Project (continued)	Thinking About Drinking	alcohol	D. Bremer	C. Berrang J. Schmidt T. Harvey
	Wellspring: What It's All About	wellspri	Dominguez A. Lomax	Dominguez
	Resources for Women	womanles	G. Hirsch	G. Hirsch

RESEARCH PROGRAMS

Educational Studies	Educational Studies: Curriculum Management	distedit	R. Venezky	K. Kahn G. Feurer
		schledit	R. Venezky	K. Kahn G. Feurer
	Gradebook	dgrader	C. J. Meisel	C. Brooks D. Herr
		dchild	C. J. Meisel	C. Brooks D. Herr
	Multi-Dimensional Scaling Survey Package	mdsfix	V. Martuza	Joseph Maia C. Prettyman R. Ozer
		mdsrun	V. Martuza	Joseph Maia C. Prettyman R. Ozer
		mdsedit	V. Martuza	Joseph Maia C. Prettyman R. Ozer
Psychology	Psych Research Index	varchive	J. Hoffman	M. Frank B. Nelson
		visindex	J. Hoffman	M. Frank B. Nelson

UTILITY PROGRAMS

Project	Title	Filename	Developer	Programmer
CIRCLe	ASCII Ouput Print Routines	asciprint	K. Kahn G. Feurer	K. Kahn G. Feurer
		datprint	K. Kahn G. Feurer	K. Kahn G. Feurer
	Catalog Edit and Search Utility	bibledit	K. Kahn G. Feurer P. LeFevre B. Sheaffer B. Lewis	K. Kahn
		biblsrch	K. Kahn G. Feurer P. LeFevre B. Sheaffer B. Lewis	K. Kahn
	Mailing Label Print Program	circmail	T. Smith K. Kahn	T. Smith
Educational Studies	Grading Utility	vgrader	R. Venezky	G. Feurer
Institutional Research	Graph Generating Program	gredit	C. Pemberton A. Williamson	B. Fortner A. Olsen M. J. Reed
OCBI	Basic Skills Data Converter	bslsconv	C. Wickham	C. Wickham
	Budget Management Package	budguse	A. Sundermier B. Seiler	A. Sundermier S. Correll
		bmanage	A. Sundermier B. Seiler	A. Sundermier S. Correll
		tparams	A. Sundermier B. Seiler	A. Sundermier S. Correll
		teditor	A. Sundermier B. Seiler	A. Sundermier S. Correll
		budgarea	A. Sundermier B. Seiler	A. Sundermier S. Correll
		budgsumm	A. Sundermier B. Seiler	A. Sundermier S. Correll
		basumm	A. Sundermier B. Seiler	A. Sundermier S. Correll

Project	Title	Filename	Developer	Programmer
OCBI (continued)	Budget Management Package	budgclus	A. Sundermier B. Seiler	A. Sundermier S. Correll
		bcsumm	A. Sundermier B. Seiler	A. Sundermier S. Correll
		tprint	A. Sundermier B. Seiler	A. Sundermier S. Correll
		sprint	A. Sundermier B. Seiler	A. Sundermier S. Correll
		clprint	A. Sundermier B. Seiler	A. Sundermier S. Correll
		budgcopy	A. Sundermier B. Seiler	A. Sundermier S. Correll
	Character Set Checker	charchek	A. Olsen	A. Olsen
	Comprehensive Accounting Analysis Package	caap	J. Wilson C. Wickham	C. Wickham S. Hart
	OCBI Equipment Inventory	inv	R. Stradling	A. Sundermier S. Correll
	Equipment Repair Requests	repair	J. Wilson C. Wickham	M. Laubach P. Smith D. Williams E. Downey
	Equipment Repair Statistics	reprstat	J. Wilson	S. Correll
	Group Records Roster Utility	roster	C. Wickham	C. Wickham
	Group Scan Deletion Utility	delete	M. Laubach M. Porter	M. Laubach M. Porter
	Group Statistics Printer	groupstats	C. Wickham	C. Wickham
	Groupstats Print Formatter	grpstatp	J. Wilson	S. Correll
	Index System	indexsys	M. Frank	M. Frank
	Inventory Search Utilities	invserch	R. Stradling	A. Sundermier J. Davis S. Correll

Project	Title	Filename	Developer	Programmer
OCBI (continued)	Inventory Search Utilities	idsort	R. Stradling	A. Sundermier J. Davis S. Correll
	Lesson Access Controller	lac	M. Laubach	M. Laubach
	Lesson Code Comparer	comparer	W. Smith B. Williams A. Semprebon	W. Smith B. Williams A. Semprebon
	Lesson List Manager	leslists	J. Trueblood	J. Trueblood
	Floppy Dataset Utility	mtcopy	J. Silver	S. Hart
	Minder: A Schedule Minder Utility	minduse	M. Laubach Joseph Maia	M. Laubach Joseph Maia
	Multi-Plotter	mplotter	J. Hoffman	M. Frank
	OCBI Logo	ocbilogo	R. Nichols	R. Nichols
	OCBI Staff Schedule Utility	thesched	B. Seiler D. Graper	B. Graper W. Stainton R. Stabosz
	OCBI Staff Schedules	mysched	B. Seiler R. Stabosz	R. Stabosz
	Time Management Utility	tmu2	M. Laubach	M. Laubach R. Stradling
	Time Report System	trfs	B. Seiler J. Sandler C. Coletta D. Tripp	D. Tripp M. Porter
	Public Hours Scheduling Utility for Willard Hall	weekend	M. Porter	M. Porter

Catalog of Programs under Development
In the Office of Computer-Based Instruction

PART II: MICROCOMPUTER LESSONS

INSTRUCTIONAL LESSONS

Project	Title	Computer	Developer	Programmer
Agricultural Engineering	Stormwater Management Alternatives	IBM PC	J. T. Tourbier	P. Sethi Milbury-Steen
Chemical Engineering	The Rankine Refrigeration Process	IBM PC	S. Sandler	M. Dombrowski L. Frank M. Frank J. Walters P. Zographon
	The Filling of Gas Cylinders	IBM PC	S. Sandler	M. Dombrowski L. Frank J. Walters M. Frank
Counseling	Custodian	Micro PLATO	L. Bloom	L. Frank S. Lesnik C. Collings
	Retail Sales Clerk	Micro PLATO	G. Sharnoff R. Sharf	L. Frank S. Lesnik R. Sutor K. Jones
	Secretary: Skills	Micro PLATO	G. Sharnoff R. Sharf	L. Frank S. Lesnik R. Sutor K. Jones Zembrzuski
Geography	Getting Acquainted	IBM PC	C. Jarom	P. Vinall
	Layout Exercise One: The Page and Map	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall
	Layout Exercise Two: Adding a Title	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall

Project	Title	Computer	Developer	Programmer
Geography (continued)	Layout Exercise Three: Titles and Legends	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall
	Layout Exercise Four: An Introduction to Digitizing	IBM PC	F. Gossette	C. Jarom P. Vinall
	Layout Exercise Five: Name Placement	IBM PC	F. Gossette	C. Jarom J. Kirk P. Vinall
	Getting Acquanted	IBM PC	C. Jarom	P. Vinall
	Layout Exercise One: The Page and Map	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall
	Layout Exercise Two: Adding a Title	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall
	Layout Exercise Three: Titles and Legends	IBM PC	F. Gossette	C. Jarom G. Reed P. Vinall
	Layout Exercise Four: An Introduction to Digitizing	IBM PC	F. Gossette	C. Jarom P. Vinall
	Layout Exercise Five: Name Placement	IBM PC	F. Gossette	C. Jarom J. Kirk P. Vinall
	Layout Exercise Six: Multi-Element Layout	IBM PC	F. Gossette	C. Jarom J. Kirk P. Vinall
	I.M.A.G.E. Tutorial	IBM PC	F. Gossette	B. Hogan C. Jarom
	I.M.A.G.E.	IBM PC	F. Gossette	B. Hogan C. Jarom J. Kirk G. Reed A. Semprebon P. Vinall B. Williams

Project	Title	Computer	Developer	Programmer
Geography (continued)	Place-Name Geography	IBM PC	Y. Schreuder	P. Hayman J. Heffernan B. Hogan C. Jarom
Geology	The Sedimentology of Flood Deposits	IBM PC	J. Pizzuto	N. Balogh M. Frank B. Hamadock D. McNeely A. O'Donnell
Mathematics	One-Variable Function Plotter	IBM PC	M. Brooks	M. Brooks E. Neufer
	Microcomputer Problem Package	IBM PC	M. Brooks	R. Payne E. Neufer
	Polar Function Plotter	IBM PC	M. Brooks	M. Brooks E. Neufer
	Parametric Curve Plotter	IBM PC	M. Brooks	M. Brooks
	Glyphs I	Apple	C. Sloyer L. Smith Tri-Analytics Inc.	T. Ferrara R. Dove J. Landis M. Wright S. Kowalski T. Gruner M. Jacobs T. Neal B. Field P. Sine L. Smith
	Glyphs II	Apple	C. Sloyer L. Smith Tri-Analytics Inc.	T. Ferrara R. Dove J. Landis M. Wright S. Kowalski T. Gruner M. Jacobs T. Neal B. Field P. Sine L. Smith

Project	Title	Computer	Developer	Programmer
Mathematics (continued)	Queues I: Constant Arrival Rates	Apple	C. Sloyer L. Smith Tri-Analytics Inc.	T. Ferrara R. Dove J. Landis M. Wright S. Kowalski T. Gruner M. Jacobs T. Neal B. Field P. Sine L. Smith
	Queues II: Simulations	Apple	C. Sloyer L. Smith Tri-Analytics Inc.	T. Ferrara R. Dove J. Landis M. Wright S. Kowalski T. Gruner M. Jacobs T. Neal B. Field P. Sine L. Smith
Music	Guido Music Learning System: Ear-Training Lessons	IBM PC	Hofstetter P. Whipple	P. Whipple
	Guido Music Learning System: Written Theory Lessons	Micro PLATO	M. Arenson J. Conrad P. Nelson	J. Conrad P. Whipple P. Nelson Philhower
	Intervals	Macintosh	Hofstetter S. Bertsche	S. Bertsche
Physical Education	Mechanics of Muscle Contraction	Micro PLATO	R. Neeves	Markham S. Hart M. Houghton

UTILITY PROGRAMS

Utility	Graphics Editor for the IBM PC	IBM PC	G. Reed L. Frank A. Sundermier	C. Green P. Zographon D. DiZio P. Ballman A. Sundermier P. Vinall

Project	Title	Computer	Developer	Programmer
Utility (continued)	Character Set Editor	IBM PC	Milbury-Steen L. Frank G. Reed	Milbury-Steen

Catalog of Programs under Development
In the Office of Computer-Based Instruction

PART III: VAX 11/780 LESSONS

INSTRUCTIONAL LESSONS

Project	Title	Computer	Developer	Programmer
Statistics	Looking at Data	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman D. Bamford D. Bennett E. Bishop M. Brittingham A. D'Ambrosio T. Carrera
	Number Line Displays	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Brooks E. Ferrara A. Godil J. Merryman Shollenberger
	Graphical Displays Based on Tallies	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman D. Bamford
	Graphical Displays Based on Rank Order	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman A. D'Ambrosio J. Merryman
	Important Characteristics of a Distribution	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Brooks A. Harbaugh Shollenberger

Project	Title	Computer	Developer	Programmer
Statistics (continued)	Transforming Data	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray E. Bishop Shollenberger
	Looking at Paired X-Y Data	VAX	V. Martuza A. Hoerl J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Brooks N. Brown N. D'Orazio
	Events and Experiments	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray D. Bennett E. Bishop
	Probability	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray W. Chen J. Lynch
	Counting Rules	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray J. Lynch
	Random Variables	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray R. Charles
	Binomial Distribution	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray R. Vogel
	Hypergeometric Distribution	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman C. Murray W. Chen

Project	Title	Computer	Developer	Programmer
Statistics (continued)	Poisson Distribution	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman W. Chen
	Density of Continuous Random Variables	VAX	A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman
	Normal Distributions	VAX	A. Hoerl V. Matuza J. Schuenemeyer	M. J. Reed D. J. Newman C. Murray R. Vogel
	Estimation Procedures	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman D. Bamford
	Confidence Intervals For The Mean	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman C. Brooks W. Chen Shollenberger
	Confidence Intervals for Paired Observations	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman C. Brooks W. Chen
	Confidence Intervals for the Difference Between Two Means	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman C. Brooks J. Synder
	Confidence Intervals for Proportions	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman R. Charles
	Hypothesis Testing: Basic Concepts	VAX	J. Schuenemeyer A. Hoerl	M. J. Reed M. Porter D. J. Newman D. Bamford
	Tests About a Mean	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman J. Lynch

Project	Title	Computer	Developer	Programmer
Statistics (continued)	Tests for Paired Observations	VAX	J. Schuenemeyer A. Hoerl V. Matuza	M. J. Reed M. Porter D. J. Newman J. C. Johnson E. Bishop E. Ferrara
	Tests for the Difference Between Two Means	VAX	J. Schuenemeyer A. Hoerl V. Maruza	M. J. Reed M. Porter D. J. Newman J. C. Johnson
	Tests for Proportions	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman J. C. Johnson D. Bennett
	Power	VAX	J. Schuenemeyer A. Hoerl V. Martuza	M. J. Reed M. Porter D. J. Newman
	Student Help Module	VAX	M. J. Reed A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman D. Bamford A. Godil R. Charles
	Instructor Help Module	VAX	D. J. Newman A. Hoerl V. Martuza J. Schuenemeyer	M. J. Reed M. Porter D. J. Newman
	Statistics Library	VAX	M. Porter	M. J. Reed M. Porter D. J. Newman D. Bamford D. Bennett M. Lavin L. Sefried T. Francis S. Wolverton
	Time Order Approach	VAX	E. Hall J. Johnson T. Thompson V. Hans A. McCutcheon	C. Leefeldt M. J. Reed J. Lynch

Project	Title	Computer	Developer	Programmer
Statistics (continued)	Dependent and Independent Variables	VAX	J. Johnson E. Hall T. Thompson V. Hans A. McCutcheon	C. Leefeldt M. J. Reed J. Lynch
	The Scientific Method	VAX	T. Thompson J. Johnson E. Hall V. Hans A. McCutcheon	C. Leefeldt M. J. Reed J. Lynch
	AMPL	VAX	F. Masterson	M. Brittingham S. Bertsche M. Porter

Spring, 1979
- New projects in health education and microcomputing
- New sites for nursing and physical education
- Grants received from the National Science Foundation for projects in psychology and chemical engineering and for the 1979 Summer Institute in Computer-Based Education for teachers of mathematics, chemistry, physics and social sciences
- Grant received from the Delaware School Auxiliary Association for the 1979 Summer Institute for the Teachers of Biology and Business
- College of Human Resources founds home economics interest group in ADCIS

Fall, 1979
- New site established in Drake Hall
- New projects started in political science and UDELI (University of Delaware English Language Institute)
- Staff additions of a manager, a peripheral design engineer, a PLATO services consultant, and four junior analysts
- New Castle County School District receives University Cooperative CBE grant from HEW
- Number of terminals increased to 120 on campus and 60 off campus

Spring, 1980
- Grants received from the National Science Foundation for projects in political science, biology, and anthropology, and for the 1980 Summer Institute in Computer-Based Education for Teachers of Mathematics, Chemistry, Physics, Biology, and Social Sciences, and for a Student Science Training Program for gifted high school students
- Provost appoints the first CBI Faculty Committee to assist in the quality control of Delaware's computer-based learning materials
- Staff reorganized with the formation of director's staff

Fall, 1980
- New projects in museum studies, SOAC, University Parallel Program, and urban affairs
- New sites for agriculture, human resources, and mathematics
- Department of Education awards Community Basic Skills Improvement grant to the Urban Coalition of Metropolitan Wilmington
- Grant received from Control Data to develop a career guidance package
- Education and psychology grant received from the Interdisciplinary Research Committee; research terminal located at the Downes Elementary School
- Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe) is founded in the College of Education
- Continuing Education begins to offer courses from the PLATO courseware library
- Staff additions of two senior analysts, one middle analyst, five junior analysts, one PLATO services consultant, four research assistants, and one secretary
- Number of terminals increased to 132 on campus and 96 off campus
- PLATO extended memory increased from one million to two million words

Spring, 1981
- New site in the Counseling Annex
- Grants received from the National Science Foundation for Leadership Training of Teachers in Computer-Based Mathematics Education, for the 1981 Summer Institute in Computer-Based Education for Teachers of Mathematics, Chemistry, Physics, Biology, Psychology, and Economics, and for a Student Science Training Program for gifted high school students
- The University becomes a Participating Institution in Control Data's Lower Division Engineering Curriculum
- Mathematics project forms national consortium which becomes special interest group in ADCIS
- CIRCLe forms special interest group for theory and research in ADCIS
- CIRCLe sponsors Faculty Retreat on Research in Computer-Based Learning
- University of Delaware Sound Synthesizer (UDSS) completed and offered for sale by OCBI
- Microcomputer classroom established in the Willard Hall Education Building